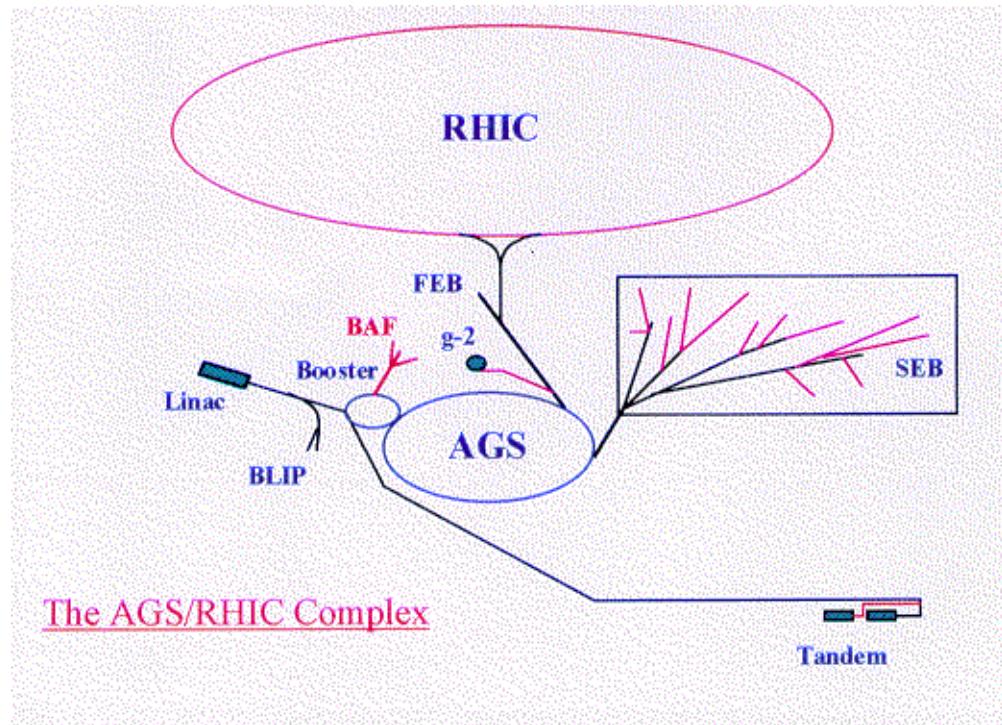


**BNL-65732**

## **AGS EXPERIMENTS IN NUCLEAR-QCD PHYSICS AT MEDIUM ENERGIES**

**1988 - 2000**

*BROOKHAVEN NATIONAL LABORATORY  
Upton, Long Island  
New York 11973-5000*



*July 1998*

***AGS EXPERIMENTS IN NUCLEAR/QCD PHYSICS AT MEDIUM ENERGIES***

P. Lo Presti

July 1998

Alternating Gradient Synchrotron Department  
Experimental Planning and Support Division

Brookhaven National Laboratory  
Brookhaven Science Associates  
Upton, New York 11973-5000  
United States of America

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## AGS Beams, July 98

Beam	GeV/c	$\delta p/p$ (% fwhm)	Prod. Angle $\Delta\Omega$ (deg)	Flux / $10^{13}$ 24 GeV/c protons on target				GeV/c	Purity	Remarks
				K <sup>+</sup>	K <sup>-</sup>	p	$\bar{p}$	$\pi^+$	$\pi^-$	
<i>Separated Charged Particle Beams</i>										
C4	$\leq 0.83$	4	0	12.0	$4.6 \times 10^6$	$1.5 \times 10^8$	$1.0 \times 10^9$	$6.0 \times 10^9$	$6.0 \times 10^9$	0.80
C6,C8	$\leq 0.75$	5	5	10.0	$1.0 \times 10^6$	$3.3 \times 10^5$	$3.3 \times 10^8$	$4.6 \times 10^4$	$2.0 \times 10^9$	0.70
D6	$\leq 1.9$	6	5	1.6	$5.5 \times 10^6$	$2.3 \times 10^4$	$3.0 \times 10^3$	$1.1 \times 10^6$	$4.9 \times 10^8$	1.80
<i>Unseparated Charged Particle Beams</i>										
A1*	5-28	3	0	0.2	$1.9 \times 10^6$	$2.9 \times 10^4$	$5.0 \times 10^3$	$2.3 \times 10^3$	$3.0 \times 10^7$	18
A2	$< 6.5$	5	3.5	0.75	$5.8 \times 10^7$	$1.9 \times 10^7$	$6.9 \times 10^8$	$1.3 \times 10^9$	$8.8 \times 10^8$	6
A3*	1-28	4	0	0.1	$6.0 \times 10^8$		$1.0 \times 10^8$	$4.0 \times 10^7$		14
B1*	5-28	3	0	0.05	$3.0 \times 10^8$		$3.0 \times 10^7$	$2.0 \times 10^7$		14
B1'	0.5-28	8	3	.001	$3.0 \times 10^4$		$6.0 \times 10^4$	$4.0 \times 10^4$		5
B2	$< 9$	5	6	0.5	$3.4 \times 10^5$	$1.2 \times 10^5$	$8.5 \times 10^6$	$9.5 \times 10^6$	$1.2 \times 10^7$	4
C1	1-29	5	0	0.8	$3.0 \times 10^7$	$3.5 \times 10^6$	$1.0 \times 10^9$	$0.7 \times 10^9$	$3.5 \times 10^8$	13
C5*	1-28	2	0	0.15		$1.0 \times 10^3$				13
<i>Neutral Beam</i>										
B5	2-20	1-4.5	0.1	$K_L^0$ flux = $1.3 \times 10^8$ @ 3.75°				2-20	$n'/K_L^0 \approx 20$	I <sub>L</sub> = 10 m - "OR" with R1
<i>Main Channel</i>										
D2	0.025-0.15	9 (π)	24 (π)	$\mu^+$ flux = $2.0 \times 10^6$				I <sub>L</sub> = 12 m Inactive, not yet commissioned		
<i>Neutrino Beam</i>										
U	$< 3.0$	0.6	0	Surface $\mu^+$ flux = $2.0 \times 10^6$				Not Presently Available FEB Flux avg. over 1.5 m R. $\langle E \rangle \approx 1.4 \text{ GeV}/c^2$ Wide Band		
V1	$\pi^- \mu^-$ Transfer Line			$\pi^+$ flux = $1.7 \times 10^8$				I <sub>L</sub> = 120, for injection to g-2 ring commissioned in 1996		
				$\mu^+$ flux = $7 \times 10^5$						

\* These  $\theta^{\circ}$  beam lines can be used for full energy polarized protons and/or heavy ion beams

# AGS Experimental Area

## FY98-99 Physics Program – Planned/In Progress

24 July 98

Proton : 25 weeks 24 GeV/c SEB

8 weeks 24 GeV/c FEB

4 weeks 24 GeV/c Polarized Protons

HI : 4 weeks 11.7 GeV/c/nucleon Au  
8 weeks RHIC Commissioning

NASA : 2 weeks 1 GeV/nucleon Fe  
1 day 11 GeV/nucleon Au

T10, E880

Partial Snake

V1,  $\pi\mu$  Beam Line

U { E938, Neutron Spallation (BES)

E939 & p945, Reaction Cross Sections

U Line

p913, Proton Radiography (DPP)

U Transfer U Line

RHIC Transfer Line

E906,  $\Lambda\Lambda$  Hypernuclei – CDS

E929,  $\Lambda$  Hypernuclei – RAI Detector

E930,  $\Lambda$  Hypernuclei – Ge Detectors

D2- $\mu$  Channel

A2-6GeV, E865,  $K^+ \rightarrow \pi^+\mu^+\bar{\nu}$

E919, NASA Radiobiology

A3 { E864, Strangelets (HI)

E941, p-A collisions

A1-MPS { E900, ISIS

E952, Exotic Mesons

B2-Test Beam (many users)

B1- E925, pp & Test Beam

E944, ACCESS/E946, BP-1 Calibration

E919, NASA Radiobiology

E941, Reaction Cross Sections

B5 (Idle)

C1-EVA, E850

Color Transparency

C5, E896, H-Search (HI)

C6-LESBIT

E913, E914, Baryon Spectroscopy – Crystal Ball

E927, K<sub>0</sub> Tests

### Legend

Blue : Nuclear/QCD

Green: Heavy Ions

Black: Other

*Experiment Multiplicity*

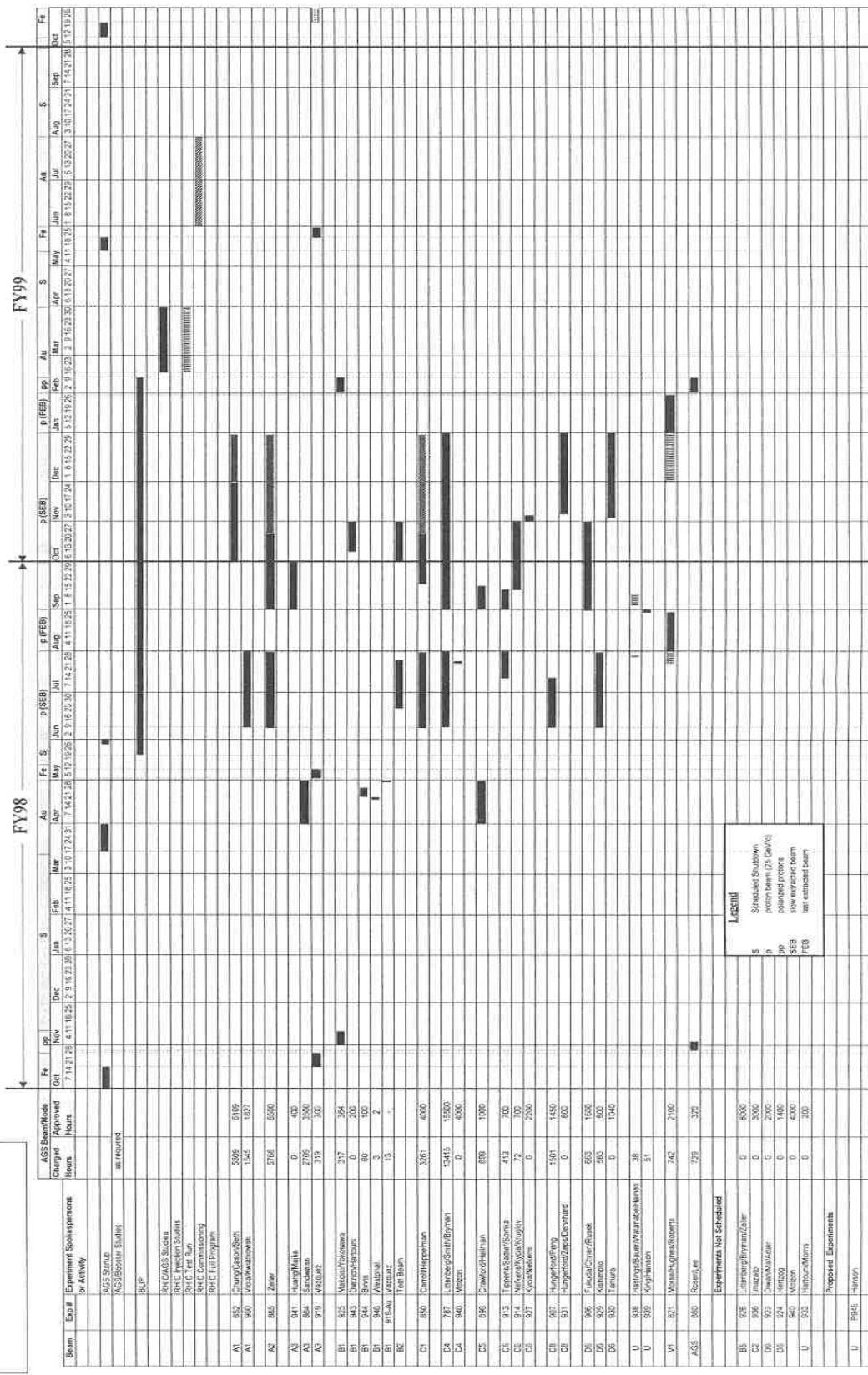
SEB  $\leq 10$

SEB+FEB  $\leq 12$

AGS Schedule, FY1998-99 (Working Copy)

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graph TD
    A[Normal Running] --> B[Subject to Approval]
    B --> C(Cycle on Demand)
    C --> D[Facility Commissioning]
    D --> E[Not in Present Financial Plan]
    E --> F[Parasitic tests]
  
```



## LIST OF NUCLEAR/QCD EXPERIMENTS

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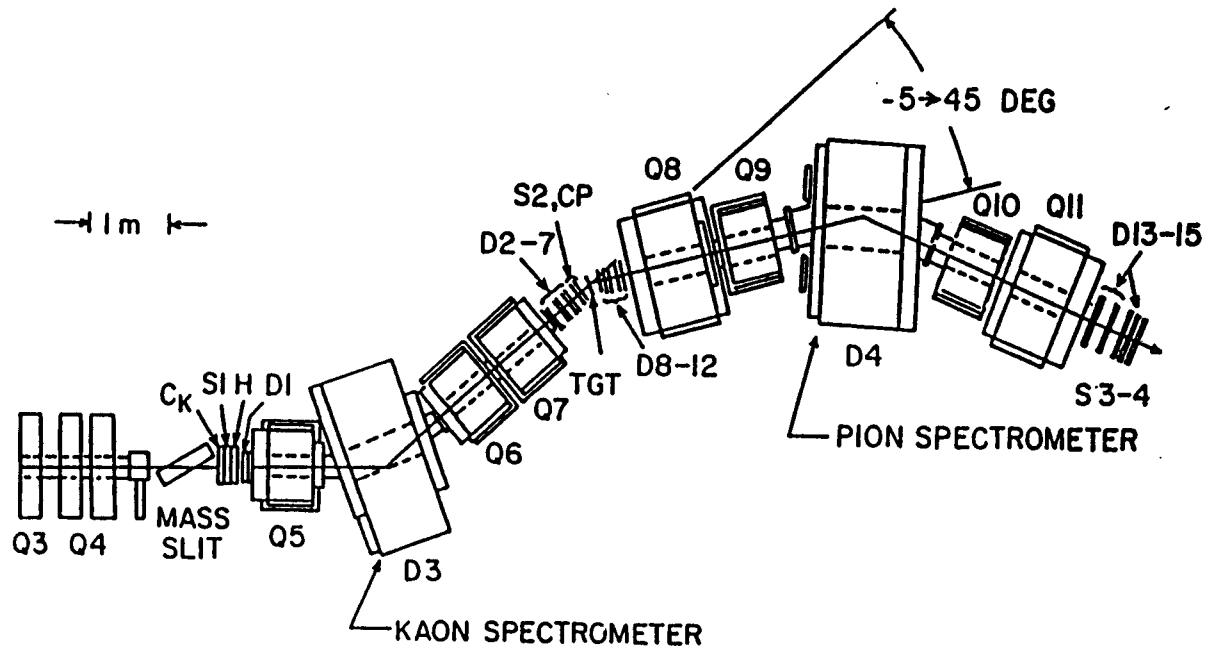
Experiment	Collaboration/Spokesmen	Page
<b>774</b>	SEARCH FOR $\Sigma$ -HYPERNUCLEAR LEVELS IN ${}^4\text{He}$ ..... E. V. Hungerford	1
<b>781</b>	SPIN DEPENDENCE OF THE LAMBDA NUCLEUS INTERACTION DETERMINED BY..... OBSERVATION OF HYPERNUCLEAR GAMMA RAYS M. May and M. Deutsch	3
<b>788</b>	THE FOUR FERMION WEAK INTERACTION AND THE DECAY OF ${}^4_\Lambda\text{He}$ AND ${}^5_\Lambda\text{He}$ ..... P. D. Barnes and G. Franklin	5
<b>811</b>	RADIATIVE KAON CAPTURE AND HYPERON WEAK RADIATIVE DECAY..... B. L. Roberts	7
<b>813</b>	SEARCH FOR A STRANGENESS -2 DIBARYON .. G. B. Franklin and P. D. Barnes	9
<b>818</b>	SEARCH FOR A $J^{PC}$ EXOTIC HYBRID MESON .. S. U. Chung	11
<b>820</b>	SEARCH FOR $S = -1$ DIBARYON RESONANCE IN THE MASS REGION (2.05 - 2.15) ..... GeV/ $c^2$ USING THE REACTION ${}^3\text{He} (K^-, \pi^+) NX$ H. Piekarz	13
<b>829</b>	SEARCH FOR $S = -1$ THREE-BODY BOUND SYSTEM .. T. Kishimoto	15
<b>834</b>	STUDY OF HADRONIC HARD SCATTERING WAVE FUNCTIONS USING ELASTIC ..... SCATTERING INSIDE NUCLEI A. S. Carroll and S. Heppelmann	17

<b>835</b>	KAON-NUCLEUS TOTAL CROSS SECTION MEASUREMENTS AND PARTIAL DECONFINE-..... MENT IN NUCLEI .....	19
	E. Piasetzky and R. E. Chrien	
<b>836</b>	SEARCH FOR A STRANGENESS -2 DIBARYON USING A ${}^3\text{He}$ TARGET .....	21
	G. B. Franklin and P. D. Barnes	
<b>838</b>	$90^0$ EXCLUSIVES AT 6 GEV ....	23
	G. Bunce and J. J. Russell	
<b>850</b>	EVA, A SOLENOIDAL DETECTOR FOR LARGE ANGLE EXCLUSIVE REACTIONS .....	25
	DETERMINING COLOR TRANSPARENCY	
	A.S. Carroll and S. Heppelmann	
<b>852</b>	SEARCH FOR MESONS WITH UNUSUAL QUANTUM NUMBERS. ....	27
	N. Cason, S.U. Chung, K. Seth	
<b>854</b>	ANTIPROTON-NUCLEUS INTERACTIONS AT 5-10 GEV/C .....	29
	B. E. Bonner	
<b>857</b>	$\pi^0$ PAIR PRODUCTION NEAR THRESHOLD AND CHIRAL SYMMETRY BREAKING .....	31
	J. Lowe and B. L. Roberts	
<b>874</b>	KAON-NUCLEUS QUASIELASTIC AND ELASTIC SCATTERING AT 720 MEV/C .....	33
	R.E. Chrien, E. Hungerford, R. J. Peterson	
<b>885</b>	EXPERIMENT TO DETECT $\Lambda\Lambda$ HYPERNUCLEI .....	35
	M. May, G. Franklin and C. Davis	
<b>887</b>	DO NARROW $\Sigma$ HYPERNUCLEAR STATES EXIST?.....	37
	R. Sawafta and K. Hicks	
<b>890</b>	A NEW TEST OF CHARGED SYMMETRY IN ETA PRODUCTION ON DEUTERIUM .....	39
	B. M. K. Nefkens, R. E. Chrien, J. C. Peng	
<b>899</b>	HIGH ENERGY PION-INDUCED NUCLEAR FRAGMENTATION .....	41
	R. J. Peterson	

<b>900</b>	ENERGY DISSIPATION AND MULTIFRAGMENTATION IN H + A REACTIONS ..... BETWEEN 2 AND 24 GEV/C	43
	K. Kwiatkowski and V. E. Viola	
<b>905</b>	SEARCH FOR A HYPERNUCLEAR BOUNDSTATE IN ${}^4\text{He}$ ( $\text{K}^-$ , $\pi^\pm$ ) REACTIONS .....	45
	T. Nagae	
<b>906</b>	EXPERIMENT TO DETECT DOUBLE- $\Lambda$ HYPERNUCLEI BY OBSERVING CHARACTERISTIC..... $\pi^-$ MESONIC DECAYS	47
	R. E. Chrien, T. Fukuda, A. Rusek	
<b>907</b>	INVESTIGATION OF LIGHT HYPERNUCLEI USING THE ( $\text{K}_\text{STOP}^-$ , $\pi^0$ ) REACTION .....	49
	E. Hungerford and Jen-Chieh Peng	
<b>909</b>	ETA PRODUCTION AT THRESHOLD IN THE REACTIONS $\pi^- \text{P} \rightarrow \eta \text{n}$ AND $\text{K}^- \text{P} \rightarrow \Delta \eta$ .....	51
	W. J. BRISCOE AND W. B. TIPPENS	
<b>913</b>	BARYON SPECTROSCOPY WITH THE CRYSTAL BALL .....	53
	M. E. Sadler, H. Spinka, W. B. Tippens	
<b>914</b>	NEUTRAL HYPERON SPECTROSCOPY..	55
	B.M.K. Nefkens, T. Kycia, S.P. Kruglov	
<b>929</b>	SPIN-ORBIT SPLITTING OF SINGLE $\Lambda$ STATE STUDIED BY THE ${}^{13}\text{C}$ ( $\text{K}^-$ , $\pi^- \gamma$ ) REACTION.....	57
	T. KISHIMOTO	
<b>930</b>	HIGH-RESOLUTION $\gamma$ SPECTROSCOPY OF HYPERNUCLEI USING LARGE-ACCEPTANCE..... GERMANIUM DETECTOR	59
	H. TAMURA	
<b>931</b>	STUDY OF THE $\Delta I = 1/2$ RULE IN THE WEAK DECAY OF S-SHELL HYPERNUCLEI.....	61
	D. DEHNARD, E. HUNGERFORD, V. ZEPS	

**EXPERIMENT 774**

[Home Page •](#)



The BNL Hypernuclear Spectrometer System as configured during the initial running phase of E774. Since then the Pion Spectrometer has been moved from the LESB-I beam line to the LESB-II beam line. The Kaon Spectrometer is now comprised of the end elements of LESB-II.

Beam: C6  
Status: completed in 1991  
Hours Charged/Approved: 1141/1150

**EXPERIMENT 774 - SEARCH FOR  $\Sigma$  -HYPERNUCLEAR LEVELS IN  $^4\text{He}$**

**Spokesmen: E. V. Hungerford**

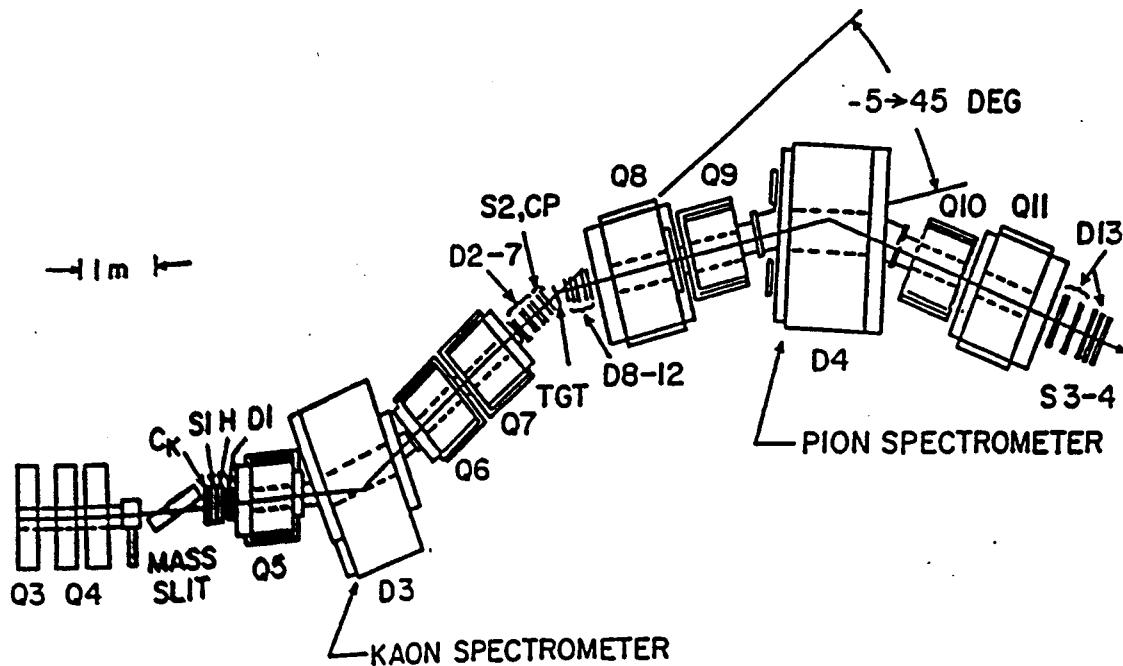
- **Brookhaven National Laboratory** - S. Bart, R. E. Chrien, P. H. Pile
  - **Vassar College** - R. Stearns
  - **University of Houston** - E. V. Hungerford, B. W. Mayes, H. Piekarsz, L. S. Pinsky
  - **University of New Mexico** - B. Bassalleck
- 

The question of narrow (2 MeV) structure in sigma hypernuclei is not completely resolved. This structure is much narrower than theoretical estimates which range from 13 to 80 MeV, and has led to much theoretical speculation as to a mechanism that could suppress the strong conversion process,  $\Sigma\text{N} \rightarrow \Lambda\text{N}$ , within the nucleus. The  $^{12}\Sigma\text{B}$  spectrum has been measured in E774. Earlier published results indicated narrow peaks (2 MeV) in the spectrum. There is no evidence for this structure in this data. All the spectra are reminiscent of final state enhancements and very similar to a spectrum calculated using the continuum shell model. In addition, there is no significant structure below threshold which should be evident if the strong conversion width is suppressed. Thus, the extraction of a sigma spin-orbit strength from these data, as has been previously done, is probably incorrect. This leaves open the whole question of a sigma spin-orbit interaction.

Data is in the final stages of analysis with publication expected in the near future.

## EXPERIMENT 781

[Home Page •](#)



the BNL Hypernuclear Spectrometer System as configured during the initial running phase of E781. Since then the Pion Spectrometer has been moved from the LESB-I beam line to the LESB-II beam line. The Kaon Spectrometer is now comprised of the end elements of LESB-II. The target is surrounded with either intrinsic germanium detectors or Nai detectors.

**EXPERIMENT 781 - SPIN DEPENDENCE OF THE LAMBDA NUCLEUS INTERACTION  
DETERMINED BY OBSERVATION OF HYPERNUCLEAR GAMMA RAYS**

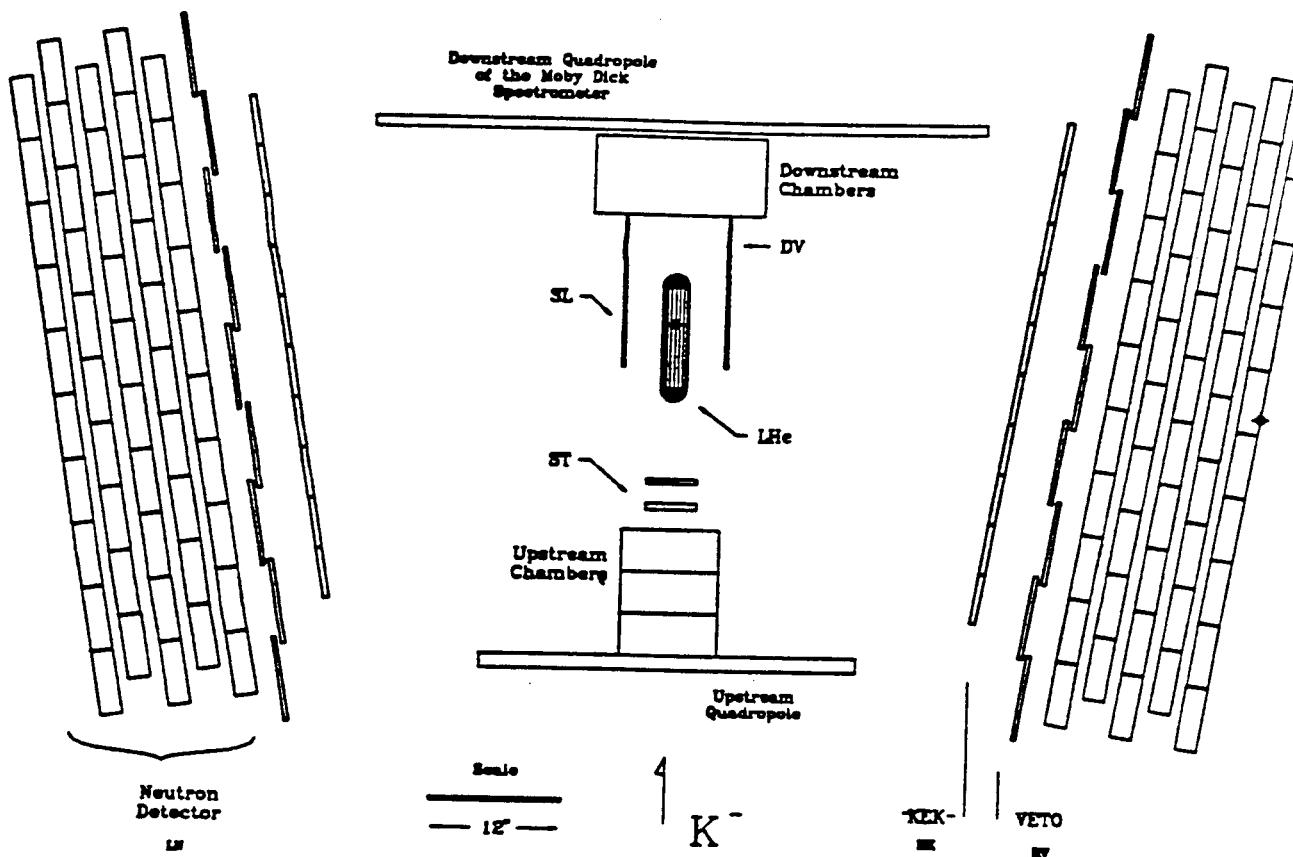
**Spokesmen: M. May and M. Deutsch**

- **Brookhaven National Laboratory** - S. Bart, R. E. Chrien, M. May, P. H. Pile
- **Carnegie-Mellon University** - P. Barnes
- **Massachusetts Institute of Technology** - M. Deutsch
- **New York University** - B. Budick
- **Vassar College** - R. Stearns
- **University of Houston** - E. V. Hungerford, B. Mayes, L. Pinsky

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This experiment measured the  $\gamma$ -ray transitions between hypernuclear states which differ only by the orientation of the  $\Lambda$  spin with respect to the angular momentum of the nuclear core. This directly measures the spin dependence of the  $\Lambda$  nucleus interaction independent of any model. The experimenters expect these spin dependent splittings to be less than 300 keV. Germanium detectors were used to observe the  $\gamma$  rays in coincidence with our sample of hypernuclear events in a narrow range of excitation energy selected by the hypernuclear spectrometer in LESBI and LESBII at the AGS. This experiment continued the research begun in Experiment 760, the first experiment to utilize this ( $K\pi, \gamma$ ) coincidence technique.

## APPARATUS



The placement of the out-of-beam detector arrays are illustrated in this plan view design drawing. A charged particle's velocity is measured from the time of flight between SL/R and L/RK. The L/RV charge-particle veto maximized the neutron detection volume by tagging charged tracks destined to the L/RN. The L/RN layers are composed of 50 elements with an active volume of about 700 liters for each side.

Beam: C6  
Status: Completed FY 1990  
Hours Charged/Approved: 959/1000

**EXPERIMENT 788 - THE FOUR FERMION WEAK INTERACTION AND THE DECAY OF  ${}^4_{\Lambda}\text{He}$  AND  ${}^5_{\Lambda}\text{He}$**

**Spokesmen: P. D. Barnes and G. Franklin**

- **Brookhaven National Laboratory** - S. Bart, R. E. Chrien, K. Johnson, P. H. Pile, R. Sawafta, R. Sutter
- **Carnegie-Mellon University** - M. J. Athana, P. D. Barnes, G. Diebold, G. Franklin, F. Merrill, B. Quinn, F. Rozon, R. Schumacher, I. Sukaton, V. Zeps
- **Indiana University Cyclotron Facility** - J. Szymanski
- **Vassar College** - R. Stearns
- **University of New Mexico** - B. Bassalleck

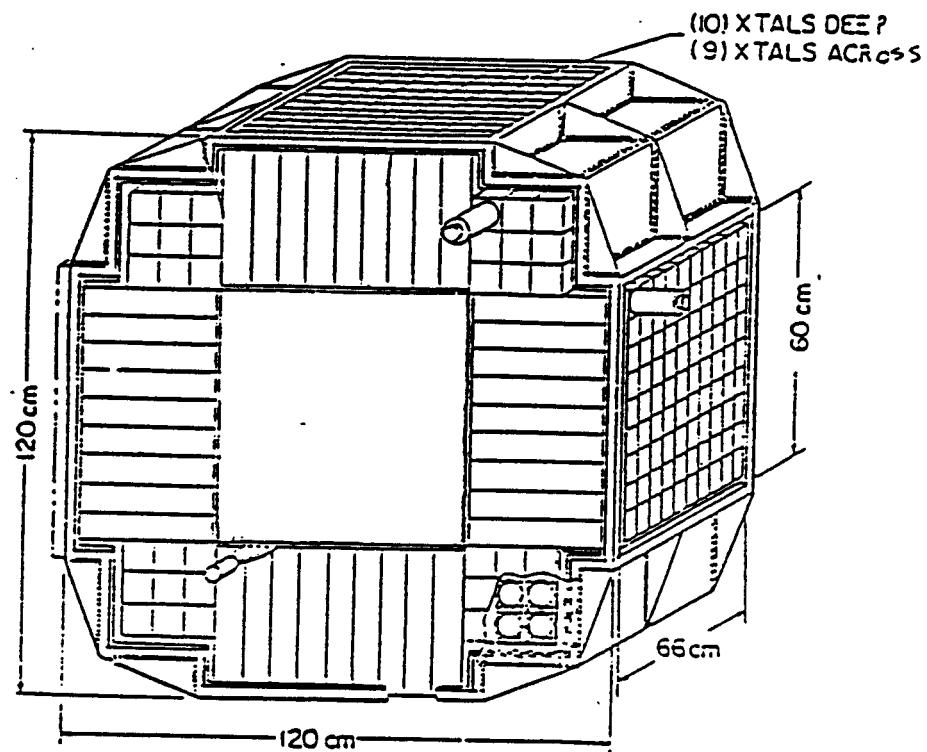
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This experiment studies the four fermion weak interaction through investigation of the  $\Lambda N \rightarrow NN$  interaction as manifested in the weak decay of hypernuclei. Using the  $K^- + A \rightarrow \pi^- + {}_{\Lambda}A$  reaction to form  ${}^4_{\Lambda}\text{He}$  and  ${}^5_{\Lambda}\text{He}$ , the measurements determine the lifetime and the four partial decay rates that characterize the weak decay. Because the  $\Lambda$  and the nucleons are all in relative s states, one can extract from the decay rates information on the elementary  $\Lambda N \rightarrow NN$  spin-isospin amplitudes.

The AGS hypernuclear spectrometer at the separated kaon beam, LESBI, was used to tag the formation of  ${}^4_{\Lambda}\text{He}$  and  ${}^5_{\Lambda}\text{He}$ . The time spectrum and energy distribution of pions, protons and neutrons were measured with a scintillator array which functions as a range stack and time-of-flight neutron spectrometer. Previous data of this type is either non-existent or of very poor quality. The lifetime measurement was based on the coincident proton spectrum with a system that has been demonstrated to be capable of  $\sigma \cong 100$  ps prompt time resolution.

**EXPERIMENT 811**

**Home Page •**



**EXPERIMENT 811 - RADIATIVE KAON CAPTURE AND HYPERON WEAK RADIATIVE DECAY**

**Spokesmen: B. L. Roberts**

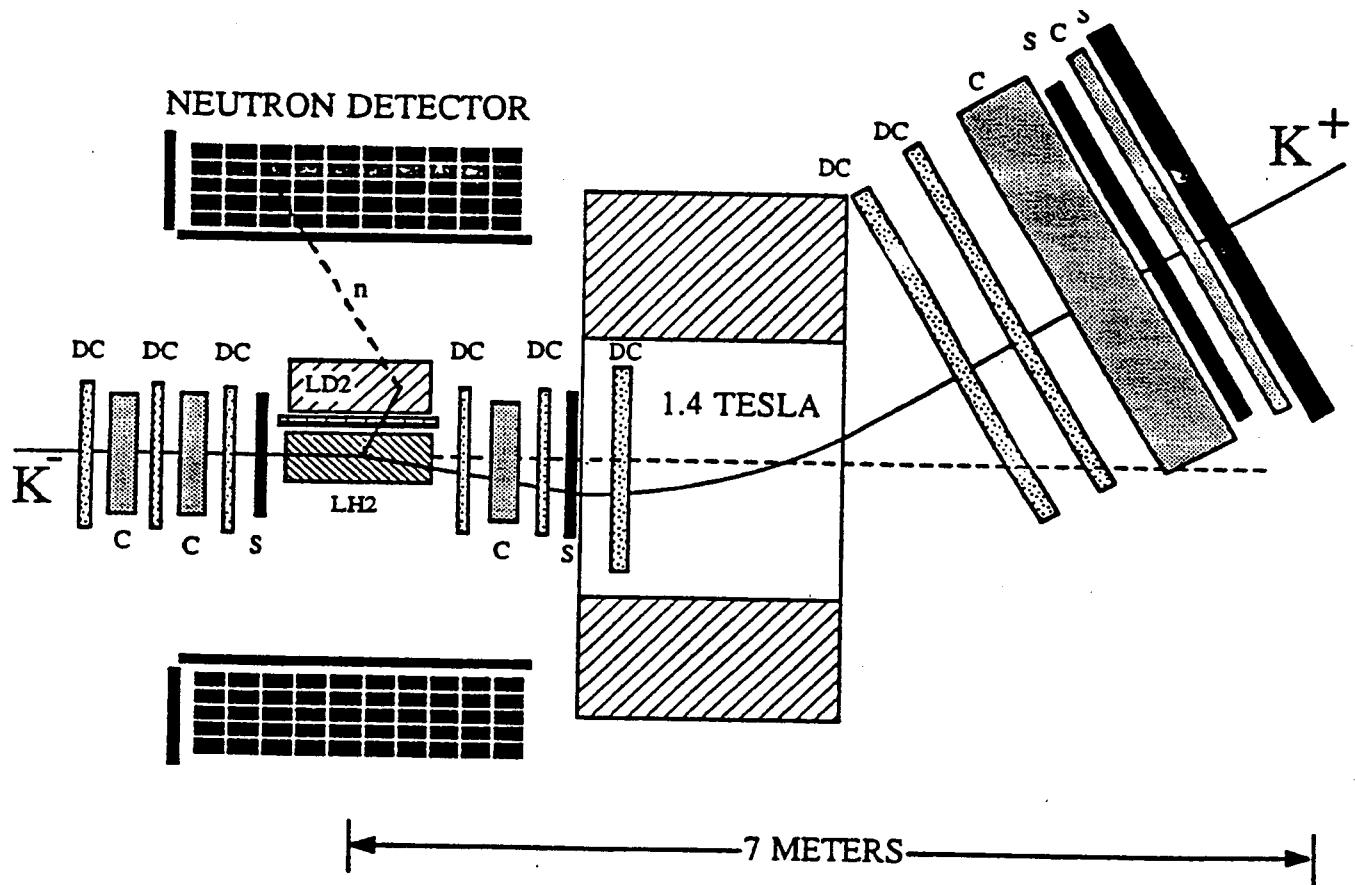
- **Boston University** - K. P. Gall, E. K. McIntyre, J.P. Miller, B. L. Roberts, T. Warner, D. Whitehouse
- **Brookhaven National Laboratory** - M. Sakitt
- **Case Western Reserve University** - W. Fickinger, D. K. Robinson
- **Central Research Institute for Physics, Budapest** - D. Horváth
- **TRIUMF** - M. Salomon
- **University of Birmingham** - N. Hesy, J. Lowe
- **University of British Columbia** - M. D. Hasinoff, D. F. Measday, A. Noble
- **University of New Mexico** - B. Bassalleck, K. D. Larson, D. M. Wolfe

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Experiment 811 consisted of two phases. In the first phase branching ratios for radiative kaon capture reactions  $K^- + d \rightarrow \Lambda + \gamma$ ,  $K^- + p \rightarrow \Sigma^0 + \gamma$ , as well as for  $K^- + d \rightarrow \Lambda + \gamma + n$  were measured.  $K^-$  were stopped in a liquid hydrogen (deuterium) target and the photon spectrum in coincidence with a stopped kaon was measured with a high resolution NaI (T1) detector. The branching ratios for the radiative capture reactions have been published. The proton results were not in agreement with simple quark model predictions, and the branching ratio for the  $\Lambda\gamma\gamma$  final state from  $K^-$  capture on deuterium was a factor of two larger than that found for the  $\Lambda\gamma\gamma$  final state from capture on hydrogen. At the same time that the radiative capture experiment was done, the branching ratio for the weak radiative decay  $\Sigma^+ \rightarrow p + \gamma$  was measured.  $\Sigma^+$  were tagged by detecting the  $\pi^-$  from  $K^- + p \rightarrow \Sigma^+ + \pi^-$  in range telescopes, and the photons were detected with a 49 element NaI (T1) array. The results agreed well with other experiments. In the second phase the branching ratio was measured for the weak radiative decay  $\Lambda \rightarrow n + \gamma$ .  $K^-$  were stopped in liquid hydrogen;  $\Lambda$  production was tagged by the monoenergetic  $\pi^0$  from  $K^- + p \rightarrow \Lambda + \pi^0$ . The LAMPF crystal box, a  $2\pi$  396 element NaI (T1) detector was used to detect photons following stopped kaons, and charged particles from the target were vetoed at the trigger level. The experiment was triggered on total energy deposited in the crystal box, and sorted off-line according to photon multiplicity.

## EXPERIMENT 813

Home Page • <http://www.phys.cmu.edu/e813/e813.html>



Schematic layout of the  $(\Xi^-,\text{d})_{\text{atom}}$  experiment. The detection of neutrons from the reaction  $(\Xi^-,\text{d})_{\text{atom}} \rightarrow \text{H} + \text{n}$  will be the signature of H particle production.

**EXPERIMENT 813 - SEARCH FOR A STRANGENESS -2 DIBARYON**

**Spokesmen: G. B. Franklin and P. D. Barnes**

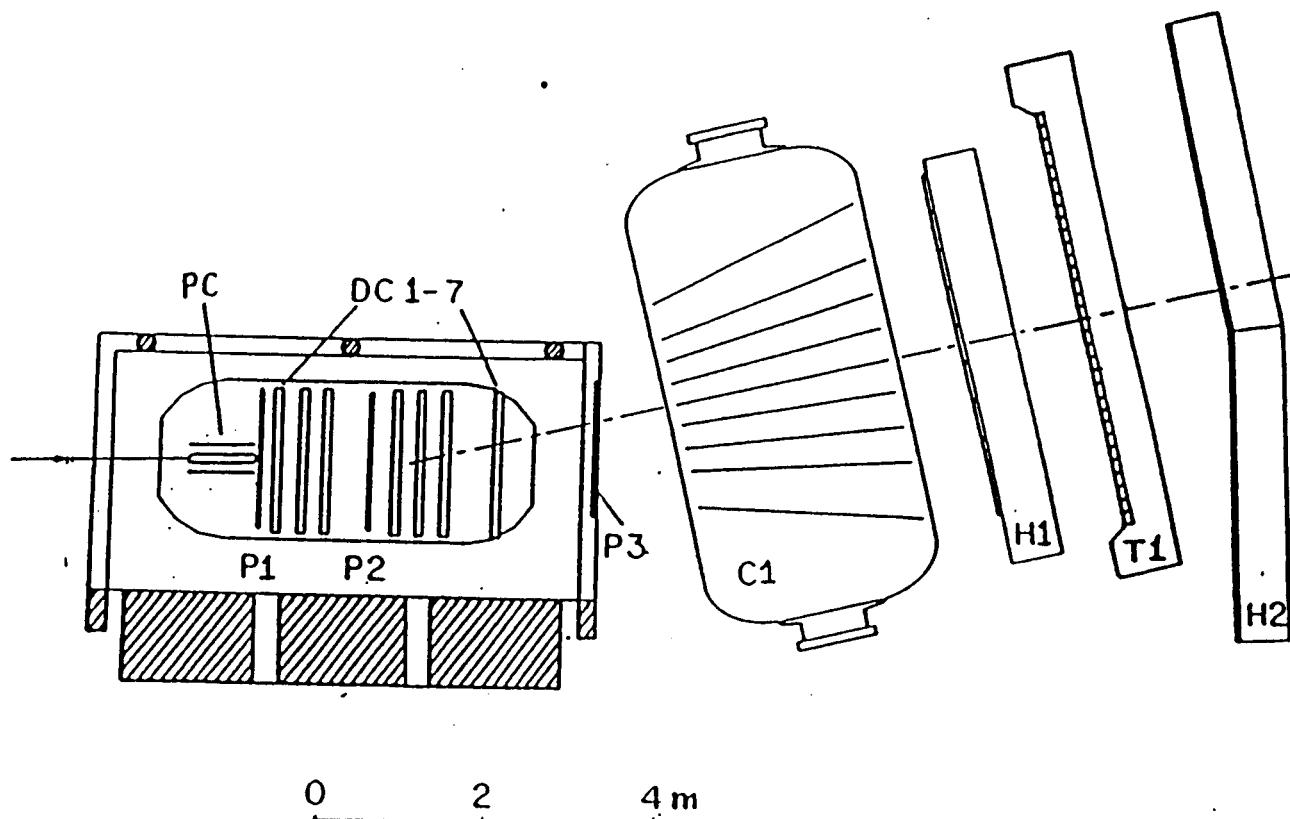
- **Brookhaven National Laboratory** - R. Chrien, P. Pile, R. Sawafta, R. Sutter
- **Carnegie-Mellon University** - A Berdoz, G. Franklin, R. Magahiz, R. McCrady, F. Merrill, C. Meyer, B. Quinn, R. A. Schumacher, R. Sukaton, V. Zeps
- **Freiburg University** - T. Buerger, M. Burger, H. Fischer, J. Franz, E. Rössle, H. Schmitt, M. Wider
- **Indiana University Cyclotron Facility** - J. Szymanski
- **LAMPF** - P. Barnes
- **TRIUMF** - D Gill
- **Vassar College** - R. Stearns
- **Yale University** - G. Diebold
- **University of Alberta** - M. Rozon
- **University of Birmingham** - J. Lowe, J. Nelson, R. Zybert
- **University of Kyoto** - H. Enyo, T. Iijima, K. Imai, N. Saito, S. Yokkaichi
- **University of Kyoto-Sangyo** - K. Okada, F. Takeutchi
- **University of Manitoba** - C. Davis, L. Gan, M. Landry, L. Lee, S. Page, D. Ramsay, V. Sum, W. vanOers
- **University of New Mexico** - B. Bassalleck, M. Chapman, A. Rusek, R. Totzer, D. Wolfe

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Motivated by Jaffe's 1977 prediction of a six-quark object with strangeness -2 and  $J^\pi=0^+$  at a mass of 2150, this experiment proposed to study the strangeness of -2 two-baryon mass spectrum from 100 MeV below the mass of the lightest known two-baryon strangeness -2 system,  $\Lambda\Lambda$  mass. This particle, called the "H", has been predicted by later bag models as well. Although the mass calculation is model dependent, the predictions are considered within the expected range of sensitivity. The possibility of resonances near the  $\Lambda\Lambda$  mass due to conventional meson exchange forces can also be explored using the experiment covers the region both above and below the  $\Lambda\Lambda$  mass.

**EXPERIMENT 818**

**Home Page •**



**EXPERIMENT 818- SEARCH FOR A  $J^{PC}$  EXOTIC HYBRID MESON**

**Spokesmen: S. U. Chung**

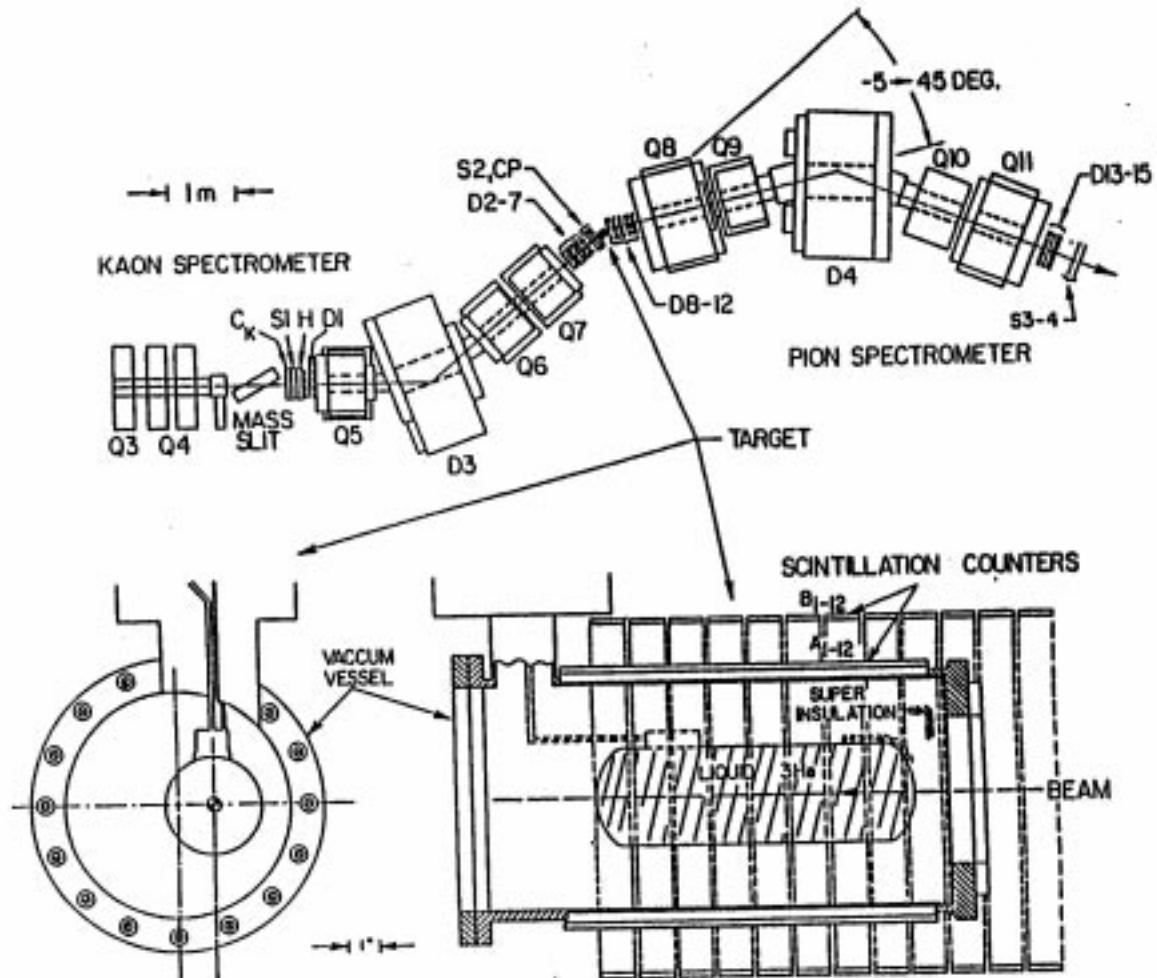
- **Brookhaven National Laboratory** - S. U. Chung, H. Kirk, S. D. Protopopescu
- **Indiana University** - R. Crittenden, A. Dzierba, T. Marshall, D. Zieminska
- **Rice Univerisity** - B. E. Bonner, G. Mutchler, J. B. Roberts
- **University of Massachusetts - Dartmouth** - N. Bar-Yam, J. Dowd, W. Kern, E. King

---

The aim of this experiment is to look for a  $J^{PC}$  exotic meson which cannot couple to a quarkonium. Such a state is expected as a hybrid meson composed of a qq in color octet - and a valence gluon. In particular, a hybrid meson with  $J^{PC} = 1\pm$  and  $I = 1$  is supposed to decay into the channels D (1285) $\pi$  and B (1235) $\pi$ .

## EXPERIMENT 820

[Home Page •](#)



The spectrometer and counter set-up of E820. Top part of the figure shows a schematic diagram of the missing mass spectrometer while the bottom part shows the liquid <sup>3</sup>He target and scintillation counters' arrangement.

**EXPERIMENT 820- SEARCH FOR S = -1 DIBARYON RESONANCE IN THE MASS REGION  
(2.05 - 2.15) GEV/C<sup>2</sup> USING THE REACTION  ${}^3\text{He}$  ( $\text{K}^-$ ,  $\pi^+$ ) NX**

**Spokesmen: H. Piekacz**

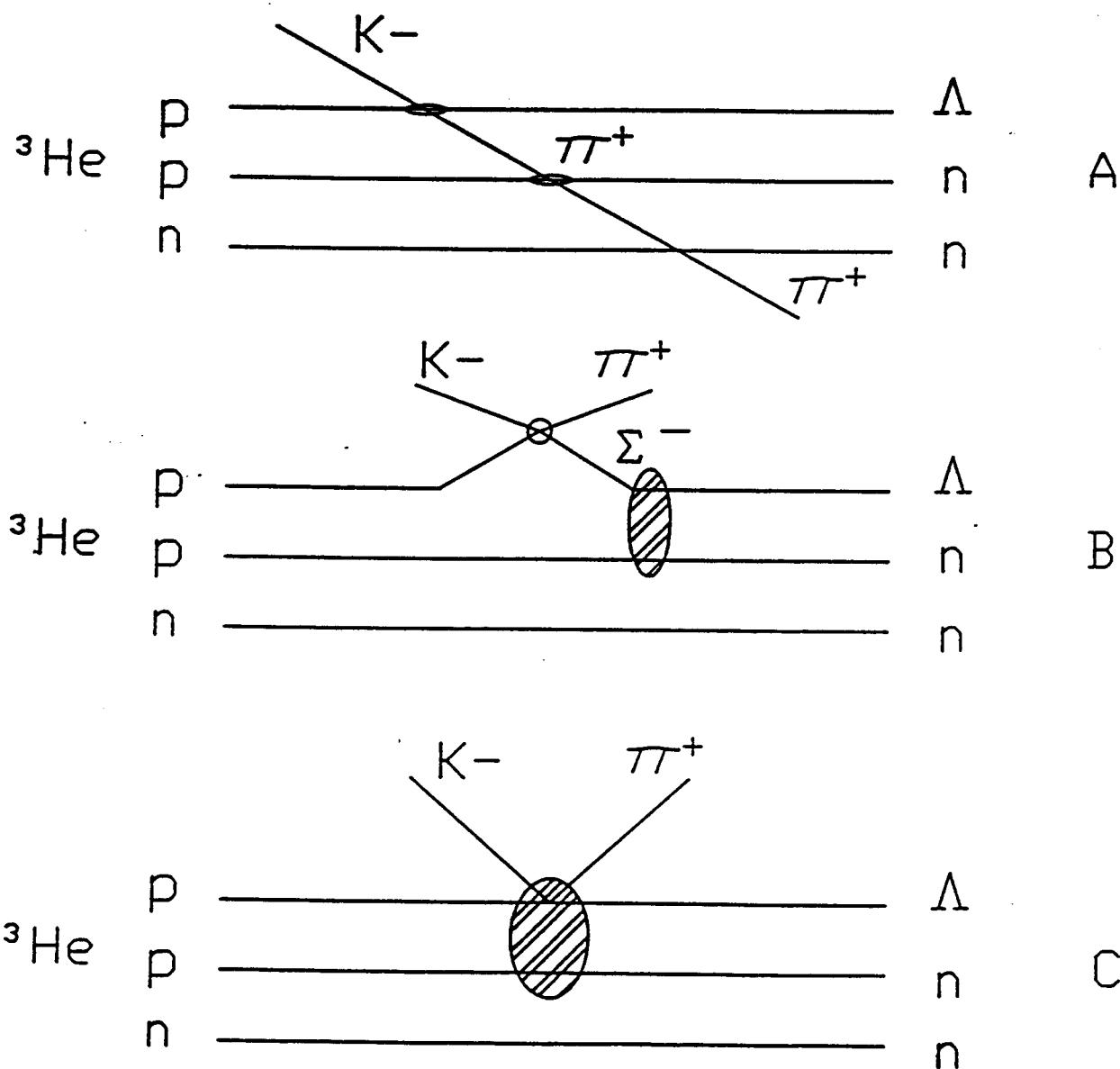
- **Brookhaven National Laboratory** - S. Bart, R. E. Chrien, P. H. Pile, N. Tsoupas, T. Ward
- **Florida State University** - H. Piekacz
- **Institute for Nuclear Studies (Tokyo)** - T. Fukuda
- **Massachusetts Institute of Technology** - M. Deutsch
- **Ohio State University** - K. Hicks
- **Osaka University** - T. Kishimoto
- **Texas A&M University** - R. Krauss
- **TRIUMF** - D. Gill
- **Vassar College** - R. Stearns
- **University of Houston** - E. Hungerford, K. Johnston, B. Mayes, L. Tang

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Experiment 820, which ran for about 600 hours during the 1988-1989 AGS slow extraction period is a search for the "bag model" predicted strangeness -1 dibaryon resonance of about 2.1 Gev/c<sup>2</sup> mass, spin 0 and orbital-parity LP = .1 using the reaction of K<sup>-</sup> mesons with <sup>3</sup>He target nuclei. This reaction was studied using the two-arm magnetic spectrometer at the LESBII beam line. The kaon beam momentum was chosen at 870 Mev/c and the scattering angle 20°. This high scattering angle enhanced the production of the p-wave resonances. The liquid <sup>3</sup>He target located between the two arms of the spectrometer was surrounded by the scintillation hodoscopes to provide the  $\Lambda$ -particle trigger as well as to reduce the kaon-in-flight decay background. The missing mass spectrum from the examined reaction was measured for about 4<sup>\*</sup>E10 K<sup>-</sup> mesons.

**EXPERIMENT 829**

**Home Page •**



**EXPERIMENT 829- SEARCH FOR S = -1 THREE-BODY BOUND SYSTEM**

**Spokesmen: T. Kishimoto**

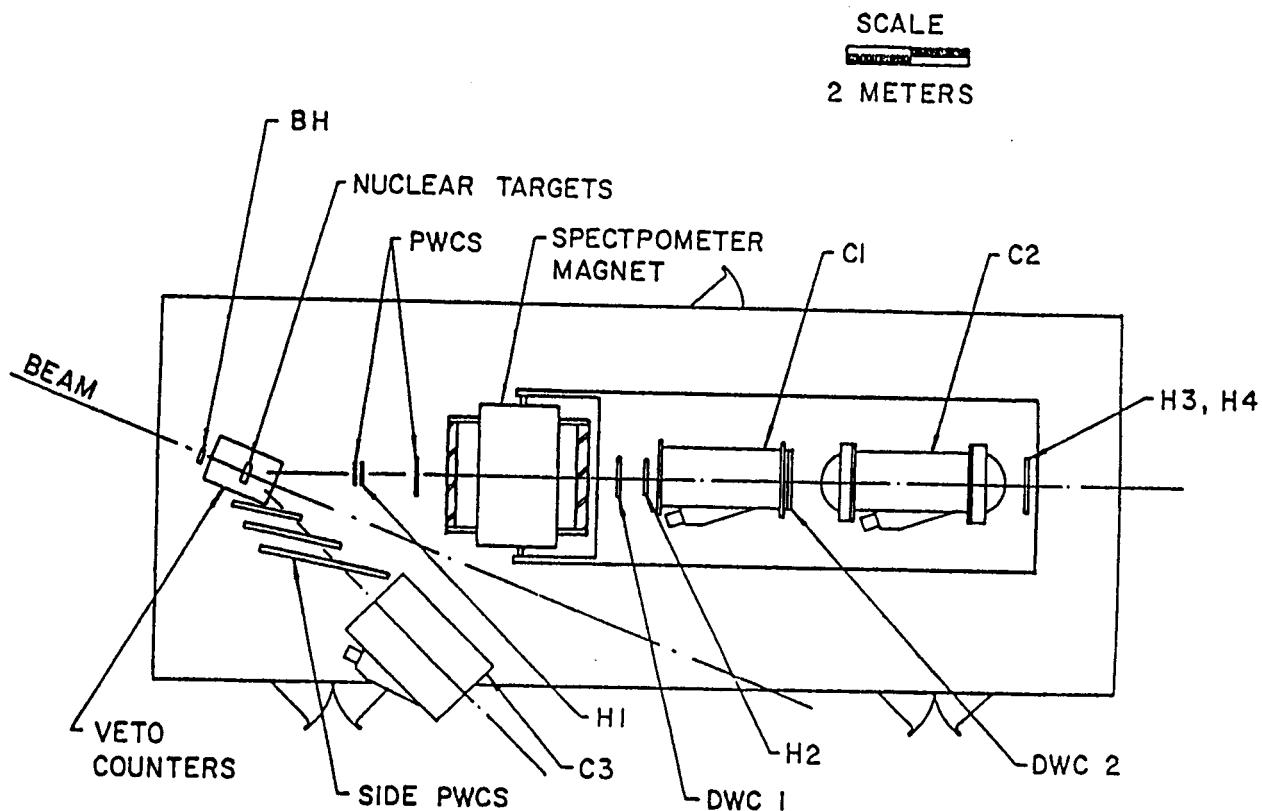
- **Brandeis University** - H. Piekarz
- **Brookhaven National Laboratory** - S. Bart, R. E. Chrien, P. H. Pile, R. J. Sutter, T. Ward
- **Massachusetts Institute of Technology** - M. Deutsch
- **Osaka University** - T. Fukuda, T. Shibata
- **Vassar College** - R. Stearns
- **University of Houston** - E. Hungerford, T. Kishimoto, B. Mayes, L. Pinsky
- **University of Texas** - M. Barlett, G. W. Hoffman

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The search for pp $\Lambda$  and nn $\Lambda$  bound systems by using the ( $K^-$ ,  $\pi^\pm$ ) reaction on a  ${}^3\text{He}$  target is proposed. Experimentation has confirmed there is no bound state in the  $S = -1$  two-body system. The lightest strange bound system experimentally known is  ${}_\Lambda {}^3\text{He}$  which has very small binding energy. Preliminary considerations predict a slightly unbound pp $\Lambda$  or nn $\Lambda$  system; this cannot be taken as conclusive because of the large uncertainties of the three-body force. Experimental confirmation is desirable.

**EXPERIMENT 834**

**Home Page •**



**EXPERIMENT 834- STUDY OF HADRONIC HARD SCATTERING WAVE FUNCTIONS  
USING ELASTIC SCATTERING INSIDE NUCLEI**

**Spokesmen: A. S. Carroll and S. Heppelmann**

- **Brookhaven National Laboratory** - D. S. Barton, G. M. Bunce, A. S. Carroll, S. Gushue, Y. I. Makdisi
- **Pennsylvania State University** - S. Heppelmann
- **Southeastern Massachusetts University** - J. J. Russell
- **University of Minnesota** - H. Courant, G. Y. Fang, K. J. Heller, M. L. Marshak, M. A. Shupe

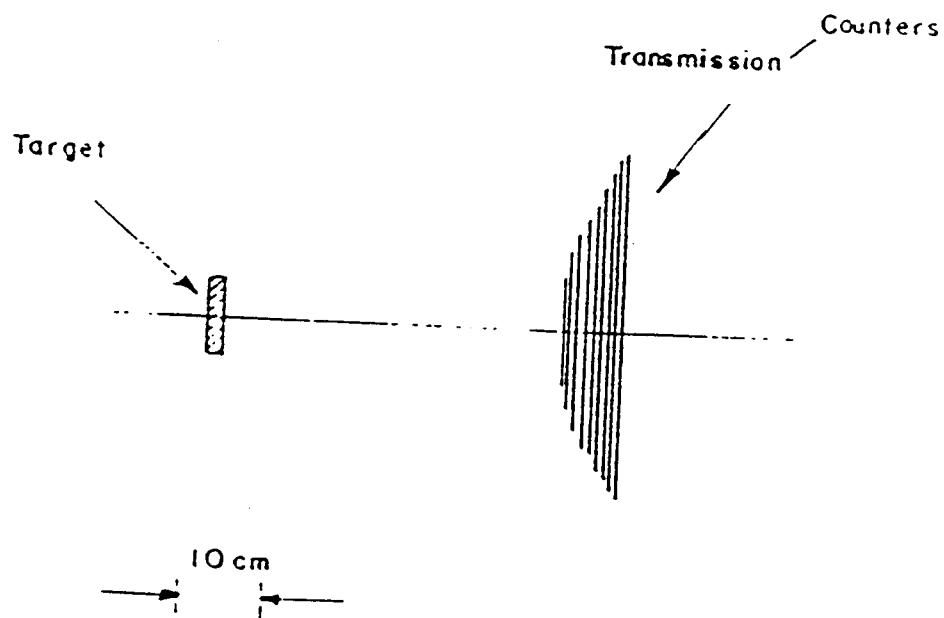
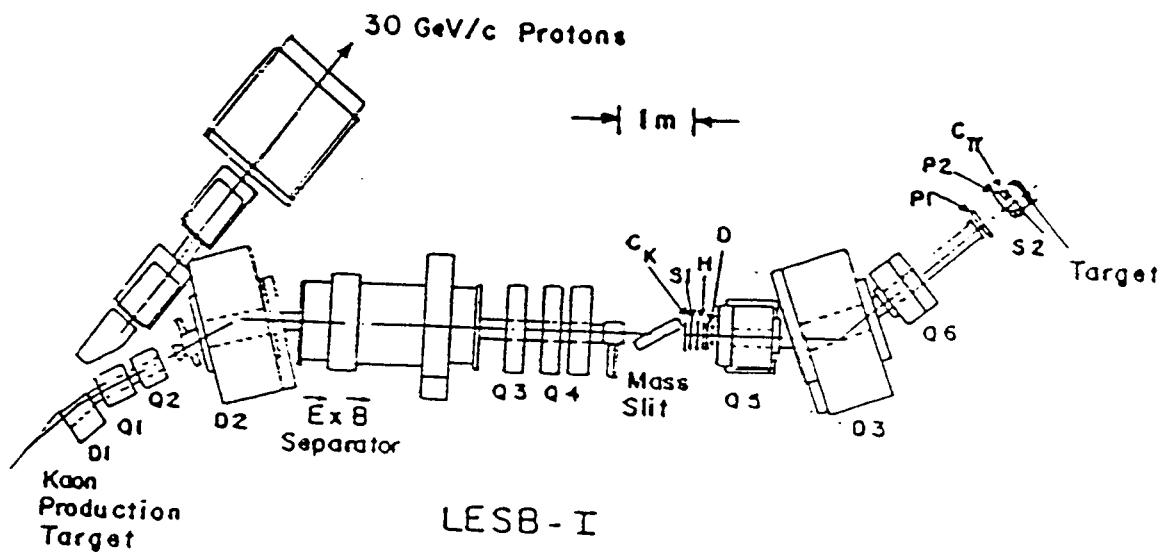
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Experiment 834 studied short distance wave functions of hadrons for the case of large  $p_t$  exclusive scattering to determine whether the basis for many large  $p_t$  perturbative calculations using Quantum Chromodynamics (QCD) is correct. These calculations assume that at the moment of interaction (and for some time before and after) the hadrons consist only of valence quarks which occupy a very small region in space. During this time, the interaction of such hadrons are anomalously small.

Using the apparatus of experiments 755, 785 and 790, elastic scattering of 10 GeV/c protons and pions form protons inside nuclei were measured. By observing the dependence on the  $A$  of the nucleus, conclusions were made whether the interaction of the incoming and outgoing hadrons were anomalously small or nearly the same as low  $p_t$  processes.

**EXPERIMENT 835**

**Home Page •**



**EXPERIMENT 835- KAON-NUCLEUS TOTAL CROSS SECTION MEASUREMENTS AND  
PARTIAL DECONFINEMENT IN NUCLEI**

**Spokesmen: E. Piasetzky and R. E. Chrien**

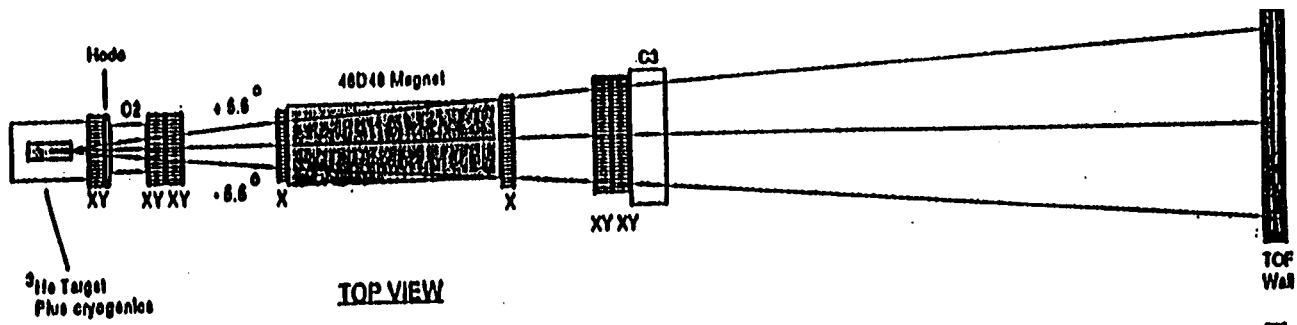
- **Brookhaven National Laboratory** - S. Bart, R. E. Chrien, T. Kishimoto, P. H. Pile, R. Sawafta, R. J. Sutter
- **Tel-Aviv University** - J. Alster, D. Ashery, J. Lichtenstadt, Y. Mardor, M. A. Moinester, E. Piasetzky, R. Weise, A. I. Yavin
- **Texas A&M University** - R. C. Hiebert, R. A. Krauss
- **TRIUMF** - R. R. Johnson, R. Olshevsky
- **Vassar College** - R. L. Stearns

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The classical view of nuclear physics is that nucleons in nuclei have the same properties as free nucleons. This approach has had substantial success; however, recent data, as well as some problems in low energy nuclear physics have led to a suggestion that the size of the nucleon increases inside the nucleus, as a consequence of a change in quark-deconfinement scale. It is important to test the hypothesis in a different momentum regime and with a different probe. A measurement of the ratio of  $K^+$ -nucleus to  $K^+$ -deuteron total cross section is proposed. This ratio of predicted to be sensitive to the proposed change in the radius of the nucleon in the nucleus.

## EXPERIMENT 836

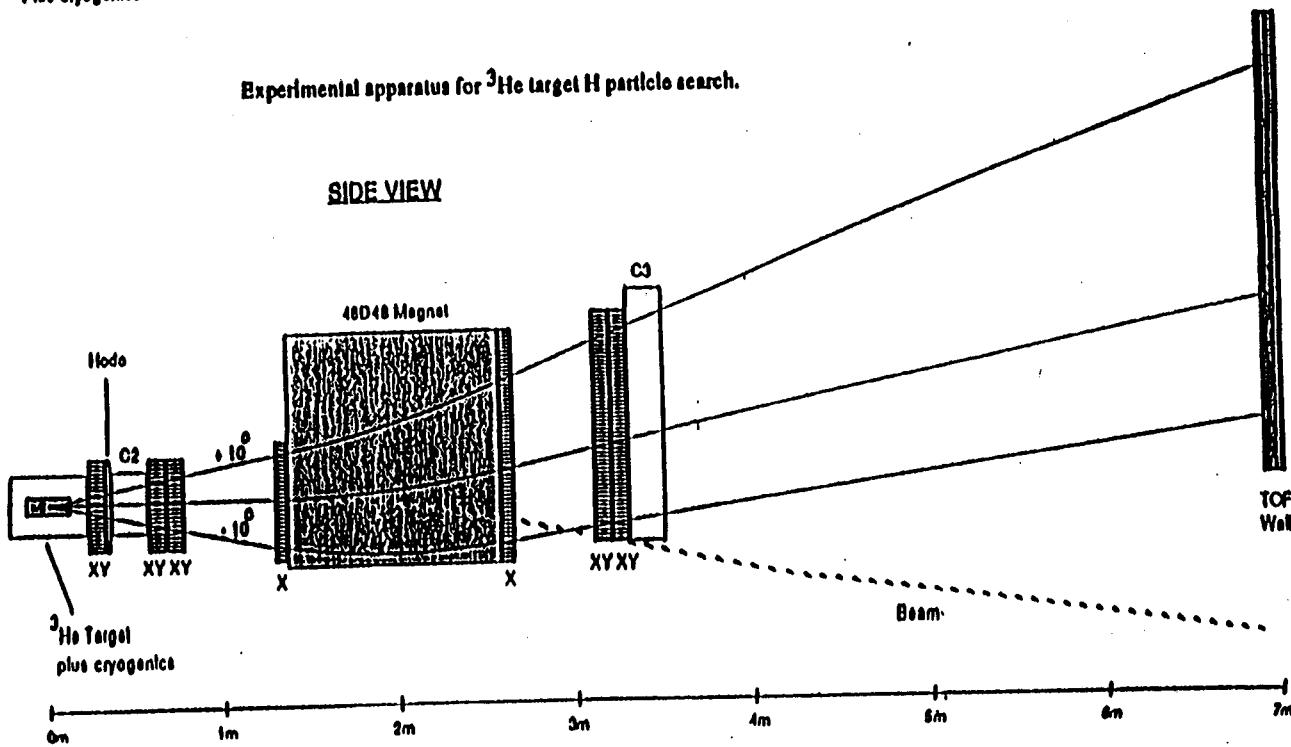
Home Page • <http://www.phys.cmu.edu/mep-index.html>



TOP VIEW

Experimental apparatus for  $^3\text{He}$  target H particle search.

SIDE VIEW



**EXPERIMENT 836 - SEARCH FOR A STRANGENESS -2 DIBARYON USING A  ${}^3\text{He}$  TARGET**

**Spokesmen: G. B. Franklin and P. D. Barnes**

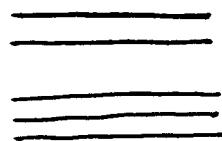
- **Brookhaven National Laboratory** - R. Chrien, P. Pile, R. Sawafta, R. Sutter
- **Carnegie-Mellon University** - A Berdoz, G. Franklin, R. Magahiz, R. McCrady, F. Merrill, C. Meyer, B. Quinn, R. A. Schumacher, R. Sukaton, V. Zeps
- **Freiburg University** - T. Buerger, M. Burger, H. Fischer, J. Franz, E. Rössle, H. Schmitt, M. Wider
- **Indiana University Cyclotron Facility** - J. Szymanski
- **LAMPF** - P. Barnes
- **TRIUMF** - D Gill
- **Vassar College** - R. Stearns
- **Yale University** - G. Diebold
- **University of Alberta** - M. Rozon
- **University of Birmingham** - J. Lowe, J. Nelson, R. Zybert
- **University of Kyoto** - H. Enyo, T. Iijima, K. Imai, N. Saito, S. Yokkaichi
- **University of Kyoto-Sangyo** - K. Okada, F. Takeutchi
- **University of Manitoba** - C. Davis, L. Gan, M. Landry, L. Lee, S. Page, D. Ramsay, V. Sum, W. vanOers
- **University of New Mexico** - B. Bassalleck, M. Chapman, A. Rusek, R. Totzer, D. Wolfe

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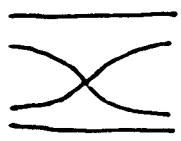
The two component target, used in the  $(\Xi, \text{d})_{\text{atom}}$  H search of Exp. 813 will be replaced with a single  ${}^3\text{He}$  target used in the reaction  $\text{K}^- + {}^3\text{He} \rightarrow \text{K}^+ + \text{H} + \text{n}$ . With the  ${}^3\text{He}$  target, greater sensitivity to a more tightly bound H is achieved. The  ${}^3\text{He}$  target is to be considered a logical addition to the two component target measurement to extend the region of sensitivity to greater values of binding energy.

## EXPERIMENT 838

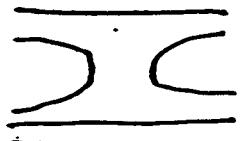
Home Page •



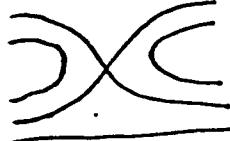
Gluon  
Exchange



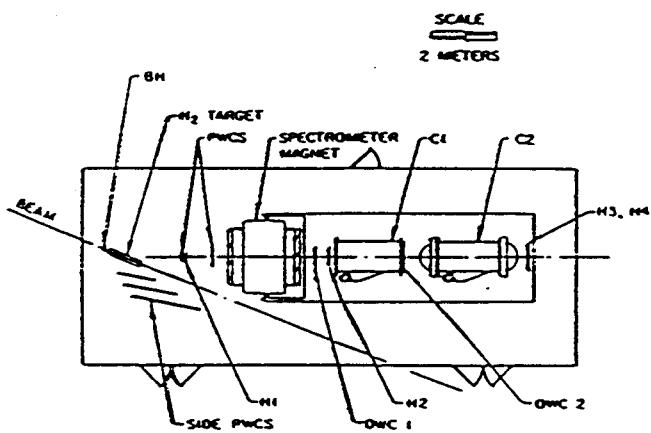
Quark  
Interchange



Annihilation/  
Creation



Quark Interch./  
Annihilation



Plan view of the detector: BH and H1-H4 are scintillation-counter hodoscopes; PWC and DWC refer to proportional and drift wire chambers; and C1 and C2 are threshold gas Cherenkov counters for pions and kaons, respectively. The spectrometer magnet bent positive particles down and defined a narrow range of production angles about  $22^\circ$  in the laboratory. ( $28.4^\circ$  for 6 GeV.)

Beam: C1  
Status: Completed FY 1988  
Hours Approved: 500

## **EXPERIMENT 838- 90<sup>0</sup> EXCLUSIVES AT 6 GEV**

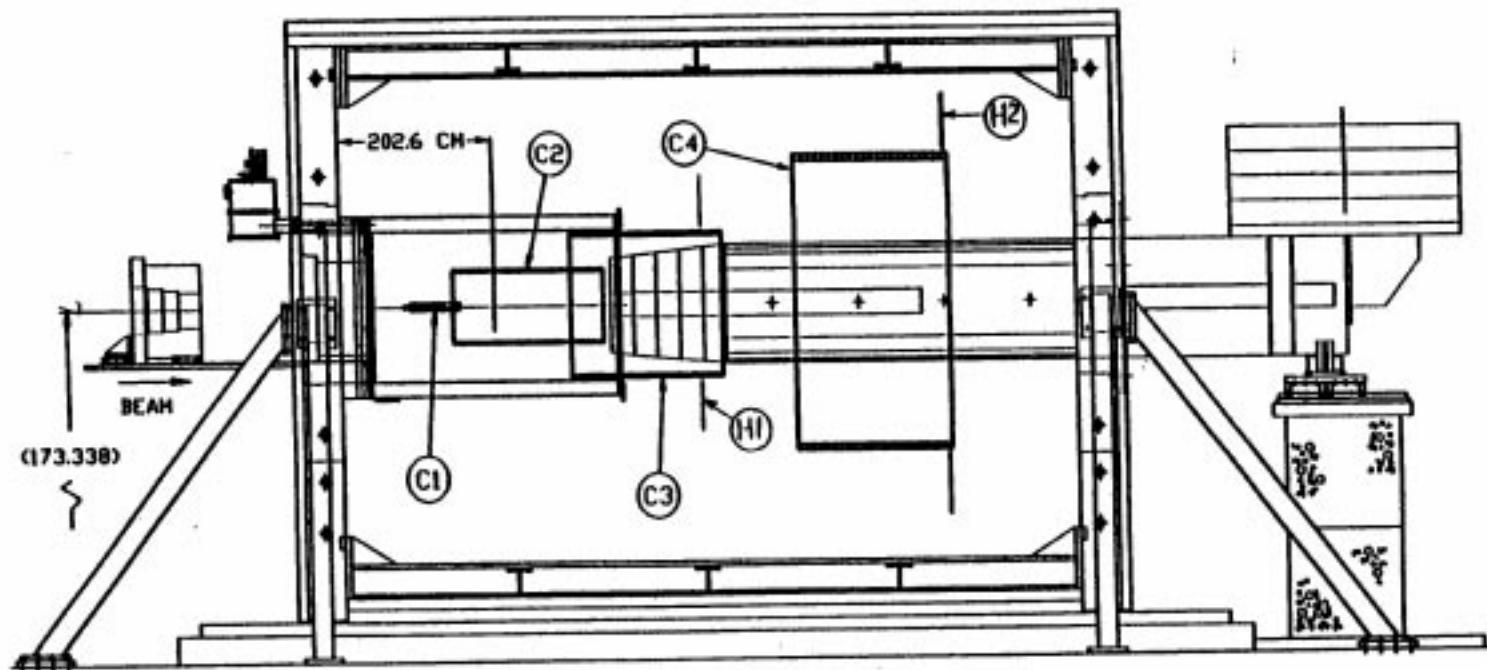
**Spokesmen: G. Bunce and J. J. Russell**

- **Brookhaven National Laboratory** - R. Appel, D. S. Barton, G. Bunce, A. S. Carroll, M. Kmit, D. Lowenstein, Y. I. Makdisi
  - **Pennsylvania State University** - S. Heppelmann
  - **Southeastern Massachusetts University** - J. J. Rusell
  - **University of Minnesota** - H .Courant, G. Fang, K. J. Heller, K. Johns, M. L. Marshak, M. A. Shupe, C. White
- 

This experiment proposes to measure or set more stringent limits on the 13 exclusive reactions at 90<sup>0</sup> CM which were studied at 10 GeV, taking advantage of the higher cross sections at 6 GeV. A factor of 3 smaller momentum bite than was used at 10 GeV will be used, improving the missing mass resolution.

## EXPERIMENT 850

Home Page • <http://www.phys.psu.edu/LEPS/EVA/eva.html>



**EVA, A SOLENOIDAL DETECTOR FOR LARGE ANGLE EXCLUSIVE REACTIONS  
EXPERIMENT 850 - DETERMINING COLOR TRANSPARENCY**

**Spokesmen: A.S. Carroll and S. Heppelmann**

**• Brookhaven National Laboratory**

D.S. Barton, G. Bunce, A.S. Carroll, S. Gushue, Y.I. Makdisi, T. Roser

**• J.I.N.R., Dubna**

Y. Panebratsev, S. Shimanskiy , I. O. Tsvetkov

**• Mt. Holyoke College - H. Nicholson, C. S. Sutton**

**• Pennsylvania State University**

V. Baturin, S. Heppelmann, A. Leksanov, E. Minor, A. Ogawa, D. Tsalov

**• Tel-Aviv University**

H. Aclander, J. Alster, S. Durant, E. Kosonovsky, I. Mardor, Y. Mardor, I. Navon, E. Piasetzky

**• University of Auckland - N. Christensen**

**• University of Massachusetts-Dartmouth - J.J. Russell**

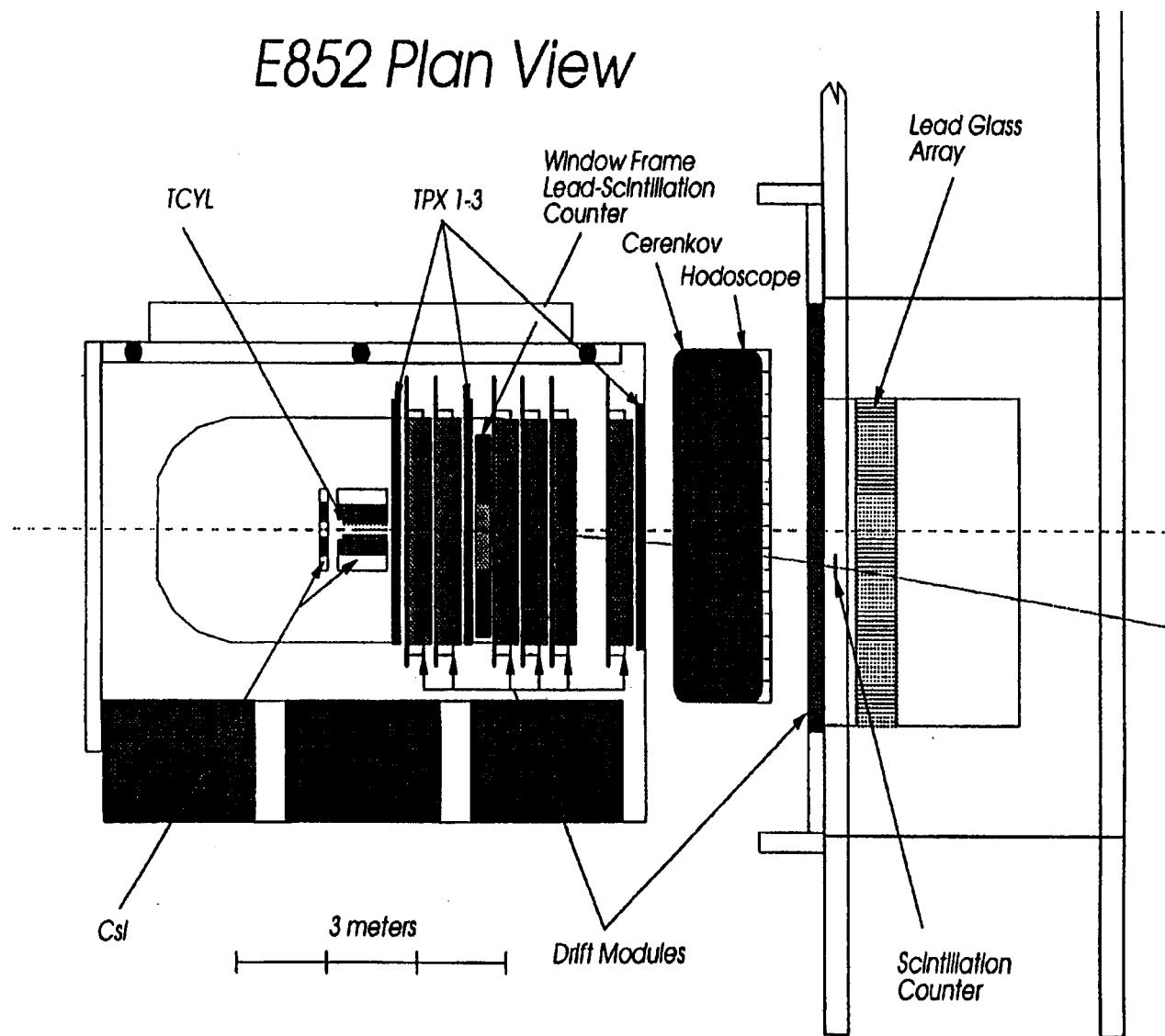
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In order to extend the range and sensitivity of measurements of large angle exclusive reactions, a new solenoidal detector, EVA, has been built. This detector increases the solid angle acceptance by over a factor of 20 over the existing dipole detector of E834, and provides for momentum measurements of all outgoing particles. The initial experiment, E850, has made new determinations of color transparency for carbon nuclei. Also measurements of carbon spectral functions at large momentum transfers were made. With a neutron detector, the correlations of neutrons associated with quasi-elastic ( $p_1 p_2 p$ ) reactions were determined. The solenoidal magnet which has not had reliable operation, has been substantially rebuilt, and now performs in a satisfactory manner.

## EXPERIMENT 852

**Home Page** • [http://www.lemond.phy.bnl.gov/~e852/home\\_e852.html](http://www.lemond.phy.bnl.gov/~e852/home_e852.html)

### E852 Plan View



## EXPERIMENT 852 - SEARCH FOR MESONS WITH UNUSUAL QUANTUM NUMBERS

**Spokesmen: N. Cason and S.U. Chung**

**Brookhaven National Laboratory** - S.U. Chung, K. Danyo-Blackett, R. W. Hackenburg, K. Olchanski, D.P. Weygand, H.J. Willutzki

- **Indiana University** - B.B. Brabson, R.R. Crittenden, A.R. Dzierba, R. Gardner, J. Gunter, R. Lindenbusch, D.R. Rust, E. Scott, P.T. Smith, T. Sulanke, S. Teige,
- **University of Massachusetts-Dartmouth** - Z. Bar-Yam, J. Dowd, P. Eugenio, M. Hayek, W. Kern, E. King
- **Moscow State University** - L. I. Belzer, V. A. Bodyagain, A. Demianoi, A.M. Gribushin, O.L. Kodolva, V.L. Korotkikh, M.A. Kostin, N. Kurglov, A.I. Ostrovidov, A. Proskuryakov, L. I. Sarycheva, N. B. Sinev, I. N. Vardanyan, A. A. Yershov
- **Northwestern University** - D. S. Brown, T. Pedlar, K. Seth, J. Wise, D. Zhao
- **University of Notre Dame** - T. Adams, J.M. Bishop, N.M. Cason, E.I. Ivanov, J.M. LoSecco, J. J. Manak, A. Sanjari, W. D. Shephard, D. L. Stienike, S. A. Taeger, D.R. Thompson
- **Institute for High Energy Physics - Protvino, Russia** - S. Denisov, V. A. Dorofeev, A. Dushkin, I. A. Kachaev, V. Kochetkov, V. Lipaev, A. V. Popov, D. I. Ryabchikov, I. Shein, A. Soldatov
- **Rensselaer Polytechnic Institute** - G. Adams, J. P. Cummings, J. Kuhn, J. Napolitano, M. Nozar, J. Smith, D. White, M. Witkowski

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Despite a number of experimental searches there is still no unambiguous candidate for a glueball, hybrid or four-quark state, although QCD predicts such objects. However, there are some tantalizing states, among them the M(1405) which has exotic  $J^{PC} = 1^+$  and the scalar G(1590) which has unusual branching ratios for a quark-antiquark state.

The experimenters will study these and other states, concentrating on decay modes of mesons with multi- photons and 0, 1 or 2 charged particles. The detector is built around the MPS. The target will be surrounded by a CsI veto, charged particle detectors and a scintillation counter. The target will be followed by charged particle detectors, a Cerenkov counter and a 3000-element lead glass calorimeter to detect photons from meson decays.

## EXPERIMENT 854

[Home Page](#) •

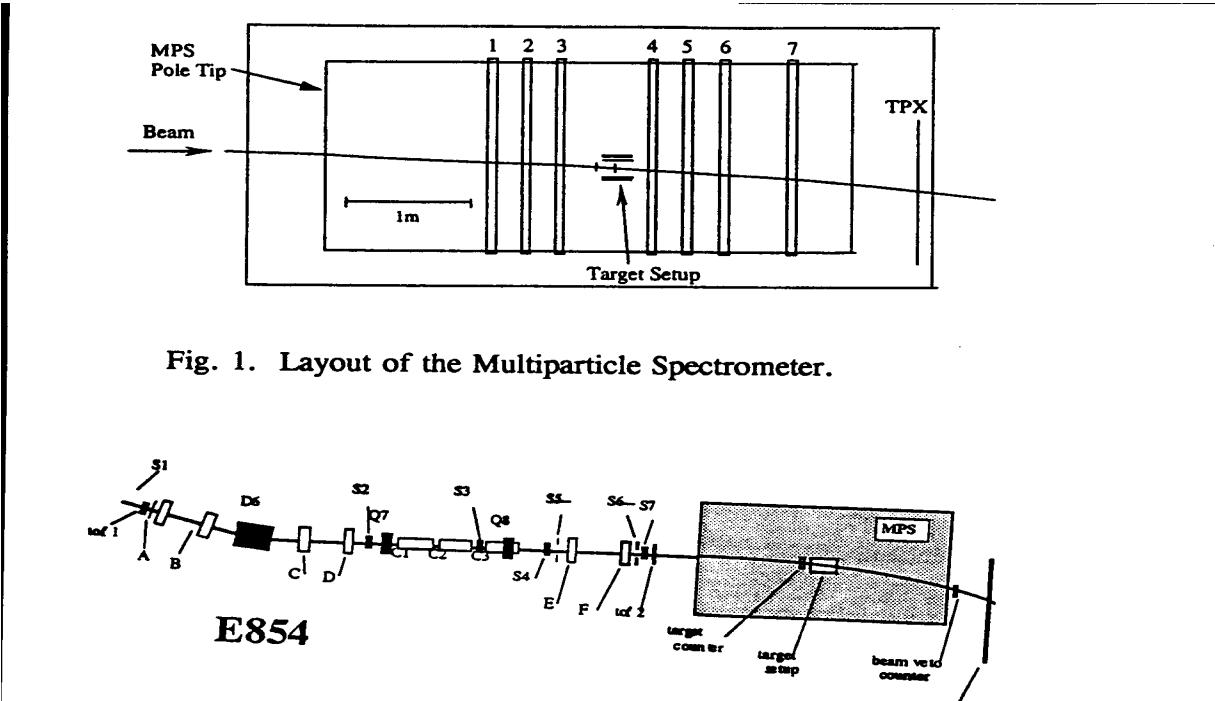


Fig. 1. Layout of the Multiparticle Spectrometer.

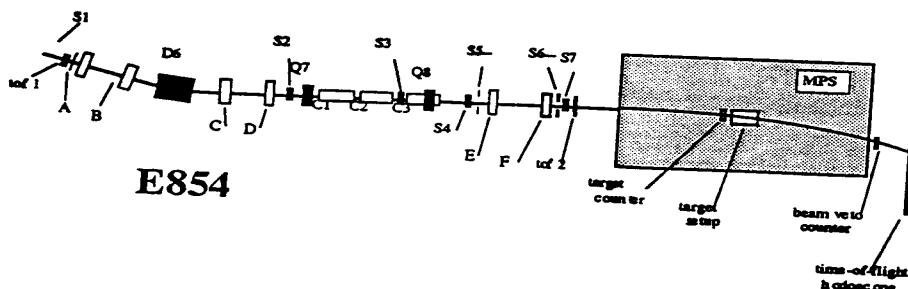


Fig. 2. Beam Line Layout.

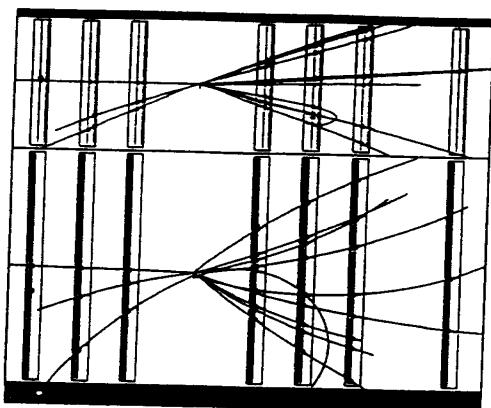


Fig. 3. A typical reconstructed event.

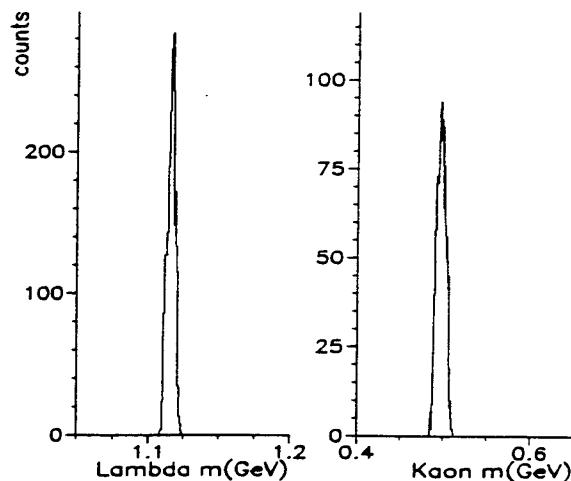


Fig. 4. A preliminary missing mass spectra.

**EXPERIMENT 854 - ANTIQUARK-NUCLEUS INTERACTIONS AT 5-10 GEV/C**

**Spokesmen: B. E. Bonner**

- **Brookhaven National Laboratory** - S. E. Eiseman, A. Etkin, K. J. Foley, R. W. Hackenburg, R. S. Longacre, W. A. Love, t. W. Morris, E. D. Platner, A. C. Saulys
- **Brookhaven National Laboratory and City College of New York** - C. S. Chan, M. A. Kramer, S. J. Lindenbaum
- **Johns Hopkins University** - L. Madansky
- **Rice University** - S. Ahmad, B. E. Bonner, J. A. Buchanan, J. M. Clement, A. Empl, G. S. Mutchler, S. Toshkov
- **University of California - Los Angeles** - T. Hallman
- **University of Maryland** - D. C. Peaslee

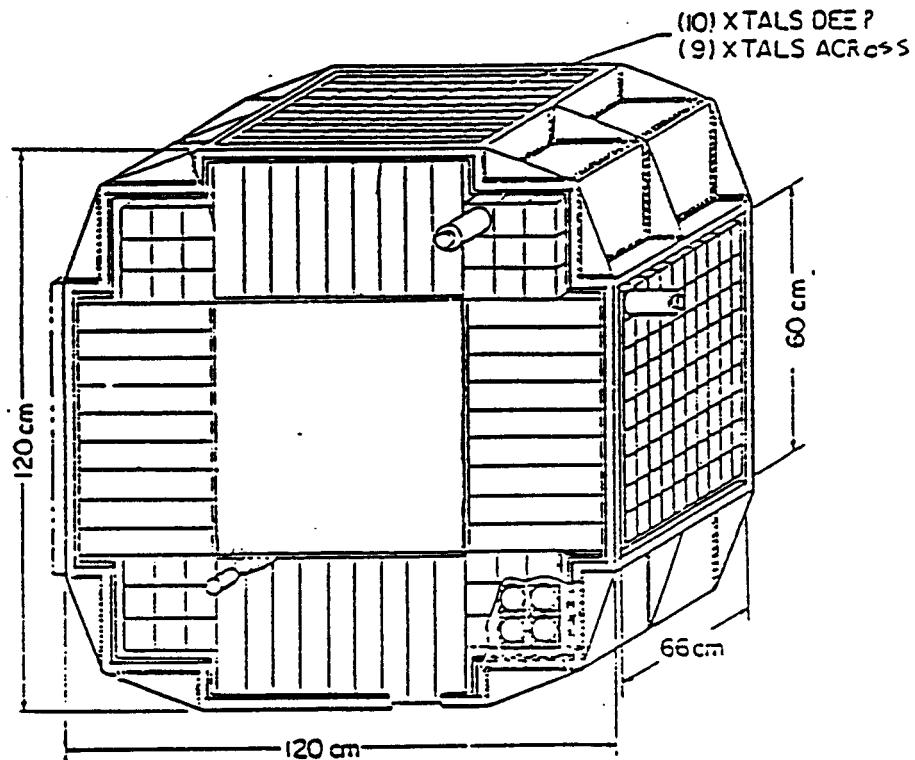
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The purpose of the experiment is to study hot hadronic nuclear matter predicted to form in the annihilation of energetic antiprotons on nuclei. This process probes the high temperature-low density region of the nuclear matter phase diagram. It is, therefore, complementary to heavy ion experimenters which access the low temperature-high density region such as AGS E810. The E854 data run occurred at the MPS facility in May-June 1991. Antiproton beams of 5, 7 and 9 GeV/c were used to interact with C, A1, Cu, Sn and Pb nuclear targets. The layout of the MultiParticle Spectrometer and the beam line elements are shown in Figs. 1 and 2 respectively.

Charged tracks were measured in both the forward and backward direction with drift chambers. In addition, the multiplicity distribution at lab angles of  $90 \pm 45$  degrees were measured with a cylindrical array of silicon diodes surrounding the target. The large angle charged particle multiplicity results are now published and the experimenters are currently in the final stage of data analysis to extract the inclusive neutral strange particle production, overall charged particle multiplicity and the rapidity distribution of lambda, anti-lambda and  $K_s$  in  $\bar{p}$  annihilation reactions. It was necessary for the experimenters to write their own tracking program to track the charged particles in both directions. A typical reconstructed event demonstrating the tracking capability is shown in Fig. 3. A very preliminary missing mass spectra of lambda and  $K_s$  from annihilations of antiproton (9 GeV/c) on Pb is shown in Fig. 4.

**EXPERIMENT 857**

**Home Page •**



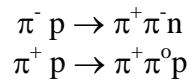
**EXPERIMENT 857 -  $\pi^0$  PAIR PRODUCTION NEAR THRESHOLD AND CHIRAL SYMMETRY BREAKING**

**Spokesmen: J. Lowe and B. L. Roberts**

- **Boston University** - J. P. Miller, B. L. Roberts
- **Brookhaven National Laboratory** - M. Sakitt
- **Case Western Reserve University** - W. J. Fickinger, D. K. Robinson
- **Central Research Institute for Physics, Budapest and TRIUMF** - D. Horvath
- **Oxford University** - N. W. Tanner
- **University of Birmingham** - J. Lowe
- **University of British Columbia** - M. D. Hasinoff, A. J. Noble, M. Sevier, C. E. Waltham
- **University of New Mexico** - B. Bassalleck, J. R. Hall, K. D. Larson, D. M. Wolfe

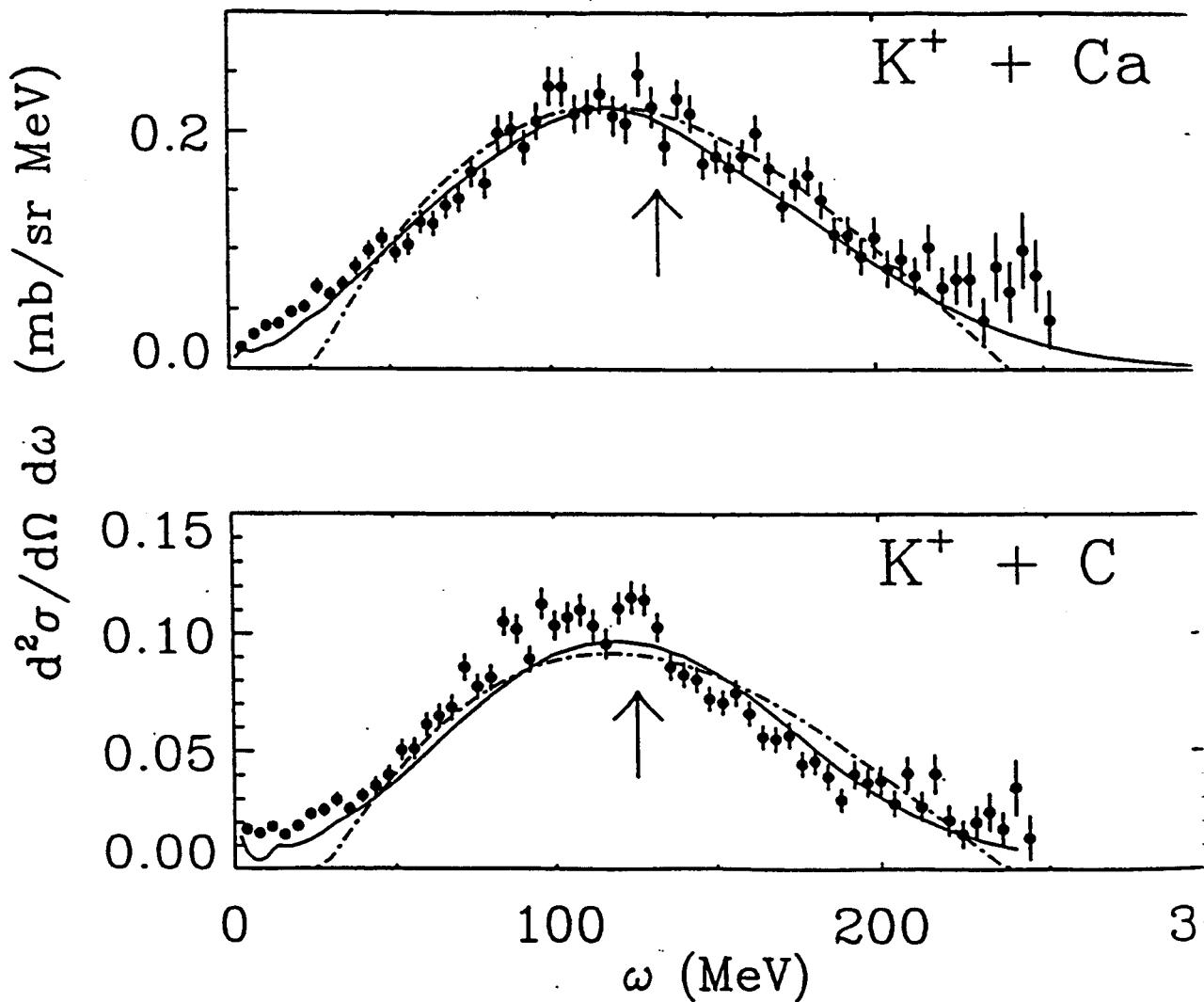
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The cross section for the reaction  $\pi^- + p \rightarrow \pi^0 + \pi^0 + n$  in the threshold region is sensitive to the chiral symmetry breaking parameter  $\xi$ , and when combined with data on the charged pion reactions



will provide a good measurement of the chiral symmetry breaking parameter  $\xi$ . In addition, this experiment can search for the  $\pi\pi$  resonance recently reported by the OMICRON collaboration, but in the neutral two  $\pi^0$  channel.

The crystal box is a 396-element NaI array, which was installed on the C8 line for experiment 811. It is an effective  $\pi^0$  detector, and is well suited to detection of the  $\pi^0\pi^0$  final state with good acceptance. During April and May 1989 measurements were made between threshold ( $P_\pi = 265$  MeV/c) up to 400 MeV/c, particularly in the region just above threshold where the cross section varies rapidly.



Doubly-differential cross sections for scattering of 720 MeV/c  $K^+$  from Carbon and Calcium at a momentum transfer  $q = 500$  MeV/c. The arrows indicate the position of scattering from free hydrogen, and the broad peaks are from quasielastic scattering. The curves are relativistic Hartree, random phase approximations for nuclear matter at the appropriate density (*dot-dashed*) and for the finite nuclei (*solid*).

**EXPERIMENT 874 - KAON-NUCLEUS QUASIELASTIC AND ELASTIC SCATTERING AT 720 MEV/C**

**Spokesmen: R.E. Chrien, E. Hungerford, R. J. Peterson**

- **Brookhaven National Laboratory** - S. Bart, R. E. Chrien, R. Sawafta, R. J. Sutter
- **Ohio University** - K. Hicks, R. Michael
- **University of Colorado** - C. Kormanyos, R. J. peterson, J. Wise
- **University of Houston** - E. Hungerford, B. W. Mayes, L. Pinsky

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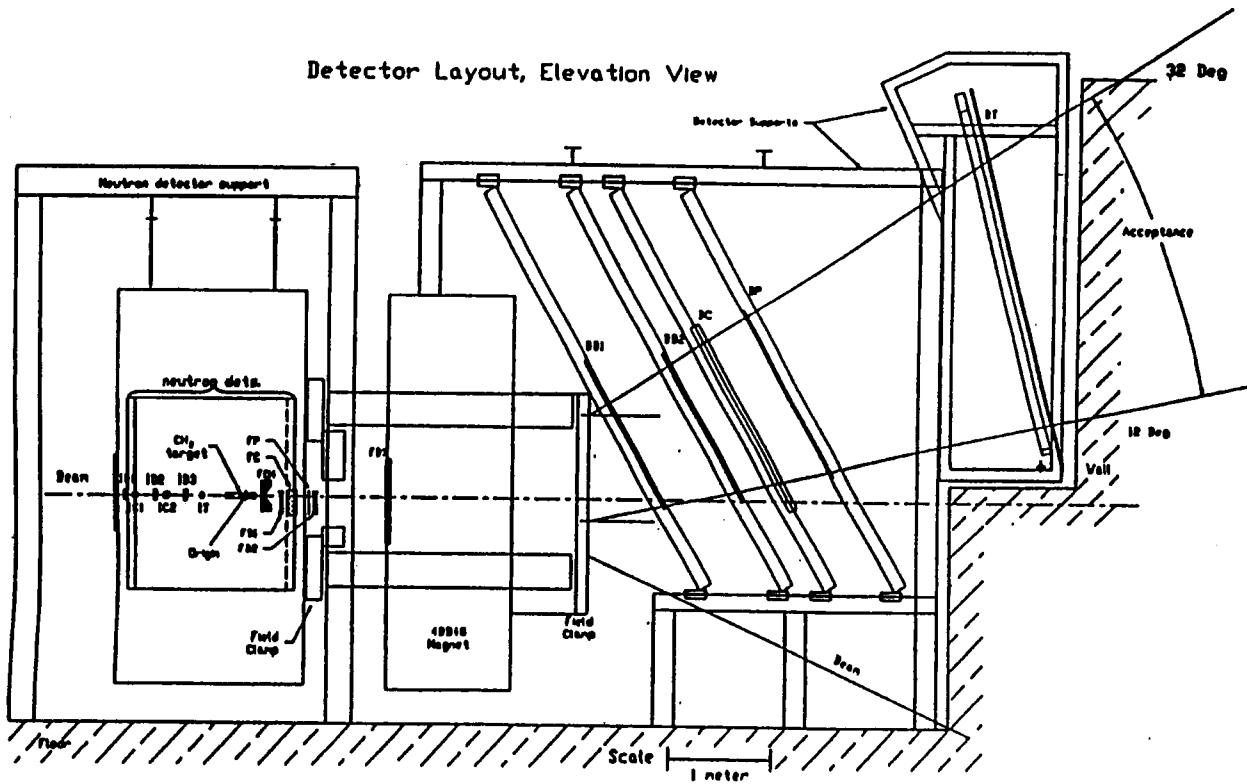
Incoherent quasielastic scattering of positive kaons should show their putatively long free path through a simple proportionality of nuclear cross sections to the number of target nucleons in isosymmetric ( $T=0$ ) targets. In this case, one can search for evidence of alternations to the free characteristics of nucleons when placed in the interior of a nucleus by precision comparison of quasielastic scattering on several  $T=0$  targets with varying volume to surface ratios. Elastic  $K^+$  scattering on some of these targets at the same beam momentum allows a similar but independent test of altered nucleons by way of optical model methods.

The experimenters have measured the quasielastic scattering of 720 MeV/c  $K^+$  from H, D, C, Ca and Pb at  $q = 300, 400,$  and  $500$  MeV, finding scattering at nuclear densities of 90%, 69%, and 55% of the central densities for C, Ca and Pb. A strongly collective response is observed at 300 MeV/c. They have measured elastic scattering of 720 MeV/c and 625 MeV/c  $K^+$  from C over a wide range of angles.

Elastic scattering from  ${}^6\text{Li}$  has also been measured. A detailed study of the spectrometer acceptance has been carried out using protons and kaons scattered from polyethylene, as well as using muons from kaon decay.

## EXPERIMENT 885

Home Page • <http://www.phys.cmu.edu/e885/e885.html>



Detector configuration for  $\Lambda\bar{\Lambda}$  experiment. Drift chambers ID1, ID2, and ID3 determine incoming  $K^-$  trajectory and are combined with upstream hodoscope data to determine  $K^-$  momentum. Drift Chambers FD1, FD2, FD3, BD1 and BD2 determine  $K^+$  momentum. Scintillators IT and BT determine  $K^+$  time-of-flight. Hodoscopes FP and BP determine spectrometer acceptance. Aerogel Cerenkovs IC1, IC2, FC, and BC reject pions. Hydrogen Cerenkov FCH rejects protons.

**EXPERIMENT 885 - EXPERIMENT TO DETECT  $\Lambda\Lambda$  HYPERNUCLEI**

**Spokesmen: M. May, G. Franklin and C. Davis**

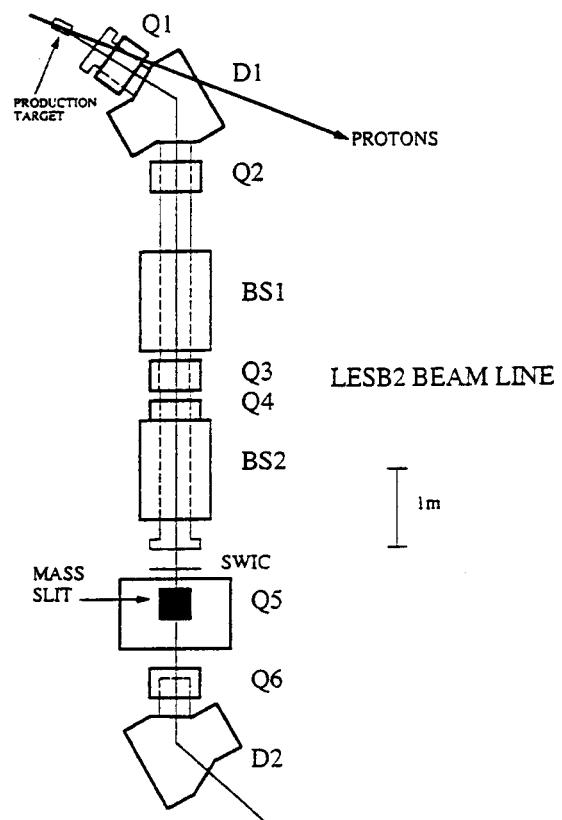
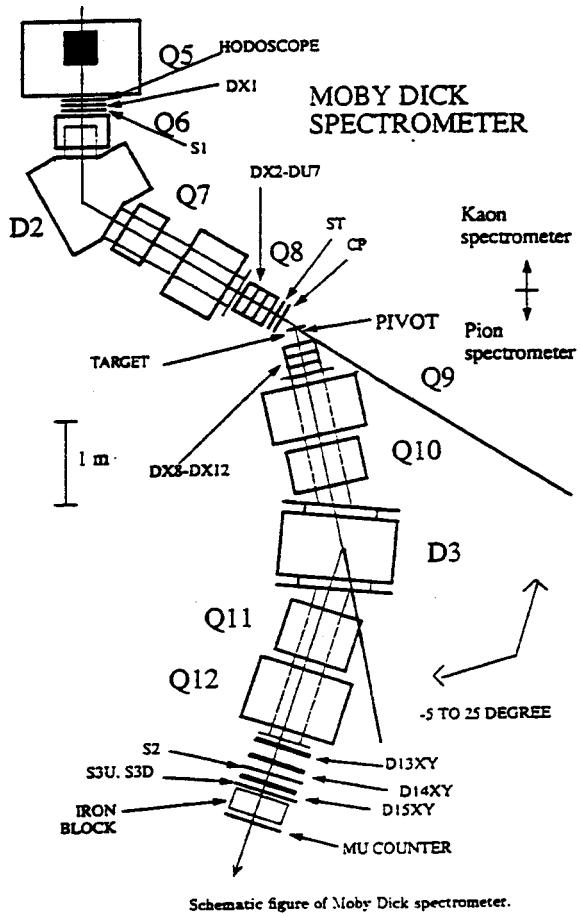
- **Brookhaven National Laboratory** - D. Alburger, R. E. Chrien, M. May, P. H. Pile, A. Rusek, R. Sawafta, R. Suter
- **Carnegie-Mellon University** - A. Bersoz, A. Biglan, D. Carman, G. Franklin, P. Khaustov, P. Koran, R. Magahiz, R. McCrady, C. Meyer, K. Paschke, B. Quinn, R. Schumacher
- **Freiburg University** - T. Bürger, H. Fischer, J Franz, K. Konigsmann, H. Schmitd
- **KEK** - T. Iijima
- **Kyoto University** - A. Ichikawa, K. Imai, Y. Kondo, K. Yamamoto, Y. Yosoi
- **Los Alamos National Laboratory** - P. Barnes, F. Merrill
- **Rutgers University** - R. Ransome
- **TRIUMF** - C. Davis, J. Doornbos
- **University of Kentucky** - V. Zeps
- **University of Kyoto-Sangyo** - F. Takeutchi
- **University of Manitoba** - J. Birchall, L. Gan, M. Landry, L. Lee, S. Page, D. Ramsay, V. Sum, W. van Oers
- **University of New Mexico** - B. Bassalleck, R. Stotzer

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The existence of properties of  $\Lambda\Lambda$  hypernuclei are intimately related to the H particle, a proposed six quark state (uddss) and the question of strange matter and strangelets. If the H exists and is sufficiently bound, two  $\Lambda$ s in a hypernucleus will fuse to form an H. The collaboration has built an experiment to form and detect  $\Lambda\Lambda$  hypernuclei by stopping many more  $X^-$  than in any previous attempt.

Running of the experiment to date has primarily utilized a diamond target for high stopping rate of short-lived  $\Xi^-$ .  $K^-$  at 1.8 GeV/c incident on a diamond target from  $\Xi^-$  which stop in the diamond and  $K^+$  which are detected in the spectrometer. Capture of  $\Xi^-$  by carbon nuclei form  $\Lambda\Lambda$  hypernuclei. A scintillating fiber array tracks hypernuclear decay products, and a large TOF array detects the formation neutron. If H particles are formed, their decays can be detected. S = .2 systems form in the initial  $K^-$  interaction will also be studied.

**EXPERIMENT 887**  
**Home Page • <http://>**



**Schematic drawing of LESB2(Low Energy Separated Beamline 2).**

Pion angular acceptance	18 msr
Pion momentum acceptance	see Figure C.2 in Appendix C
Energy resolution	4.2 MeV FWHM

**Performances of the Pion spectrometer**

**EXPERIMENT 887 - DO NARROW  $\Sigma$  HYPERNUCLEAR STATES EXIST?**

**Spokesmen: R. Sawafta and K. Hicks**

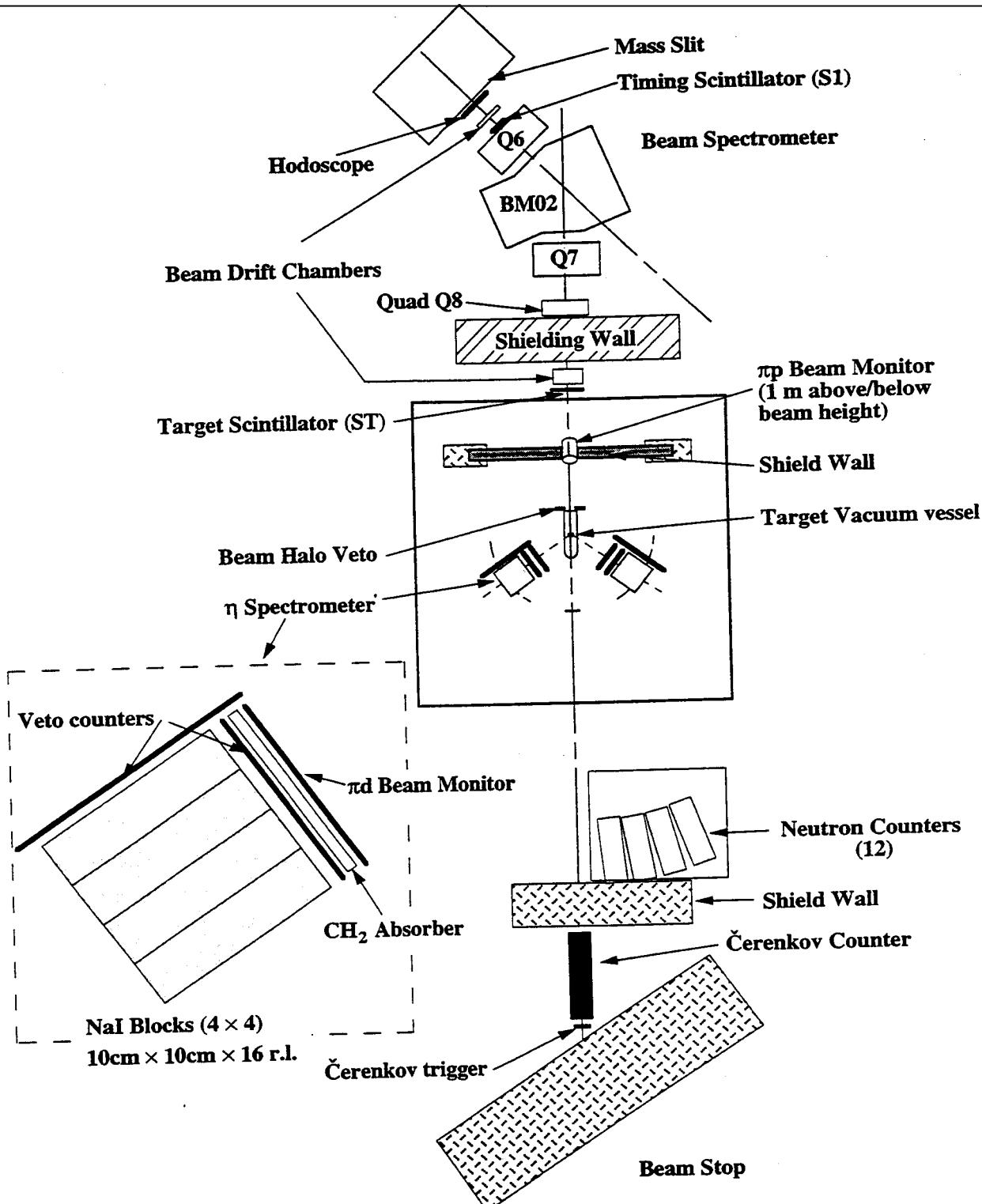
- **Brookhaven National Laboratory** - S. Bart, R. E. Chrien, R. Sawafta
- **CEBAF and Hampton University** - K. Baker, W. Naing, L. Tang
- **INS-Tokyo** - T. Fukuda, T. Nagae, H. Outa
- **Ohio University** - K. Hicks, R. Michael
- **Yale University** - M. Barakat
- **University of Houston** - K. Gross, E. V. Hungerford, B. Mayes, I. Zhu
- **University of Indiana** - W. Franklin, S. W Wissink
- **University of Tokyo** - R. S. Hayano, Y. Shimizu

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Recently, hypernuclear mass spectra for in-flight ( $K^-$ ,  $\pi^\pm$ ) reactions from  $^1H$ ,  $^2H$ ,  $^6Li$ , and  $^9Be$  have been measured at  $p_K = 600$  MeV/c. The new ( $K^-$ ,  $\pi^\pm$ ) spectra have greatly changed the experimental situation with regard to the narrow structures above the  $\Sigma$  binding threshold. The experimenters have obtained spectra with almost 10 times better statistics than previous measurements, the preliminary analysis of the data show no evidence of any of the putative structure. A detailed comparison of the new and old data sets makes clear that the earlier claims have an inadequate statistical foundation, and hence all previously claimed examples of such narrow structure in the unbound energy region can be excluded.

## EXPERIMENT 890

Home Page • <http://ucla5.phy.bnl.gov/htdocs/e890/e890.html>



**EXPERIMENT 890 - A NEW TEST OF CHARGED SYMMETRY  
IN ETA PRODUCTION ON DEUTERIUM**

**Spokesmen: B. M. K. Nefkens, R. E. Chrien, J. C. Peng**

- **Abilene Christian University** - M. Sadler, L. D. Isenhower
- **Brookhaven National Laboratory** - R. E. Chrien, R. Sawafta, R. J. Sutter
- **Forschungszentrum Jülich** - H. Seyfarth
- **George Washington University** - W. Briscoe, T. Morrison, Z. Papandreou
- **JINR, Dubna** - A. Efendiev
- **Los Alamos National Laboratory** - M. J. Leitch, J. C. Peng
- **Ruder Boskovic Institute** - M. Batini , A. Maruši , I. Šlaus, A. Švarc
- **Petersburg Nuclear Physics Institute** - V. V. Abaev, V. S. Bekrenev, N. G. Kozlenko, S. P. Kruglov, A. B. Starostin
- **University of California-Los Angeles** - M. J. Clajus, S. McDonald, T. Moriwaki, B. M. K. Nefkens, J. W. Price, W. B. Tippens, D. B. White

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The experimenters have measured the ratio of  $\eta$  production on deuterium by positive and negative pions over the momentum range from 640 MeV/c to 755 MeV/c. This range spans the onset of the  $S_{11}(1535)$  resonance, which has a very large branching ratio for  $\eta$  decay. The  $\eta$ s are observed by detection of the photons from the neutral decay of the into two photons.

The measurement of this ratio is a direct test of the validity of charge symmetry in this unexplored domain of nuclear physics. Violations of the symmetry are to be expected because of  $\pi^0$ - $\eta$  mixing.

The experiment showed large asymmetries, ranging up to over 10% at the highest momentum pions.

A preliminary fit of the data to a model of  $\eta$  production which includes  $\pi^0$ - $\eta$  mixing as the only adjustable parameter requires a value for the mixing angle of  $\sim 1\text{--}2^\circ$ . This is the first direct evidence of  $\pi^0$ - $\eta$  mixing in a nuclear environment .

The experiment also demonstrated the power of the AGS as a potent source of  $\eta$  mesons.

**EXPERIMENT 899**

**Home Page •**

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**EXPERIMENT 899 - HIGH ENERGY PION-INDUCED NUCLEAR FRAGMENTATION**

**Spokesmen: R. J. Peterson**

- **Federal University of Rio de Janeiro** - S. de Barros
- **PINSTECH** - H. A. Khan, N. A. Khan
- **University of Colorado** - R. J. Peterson
- **University of the State of New York at Stony Brook** - R. McGrath

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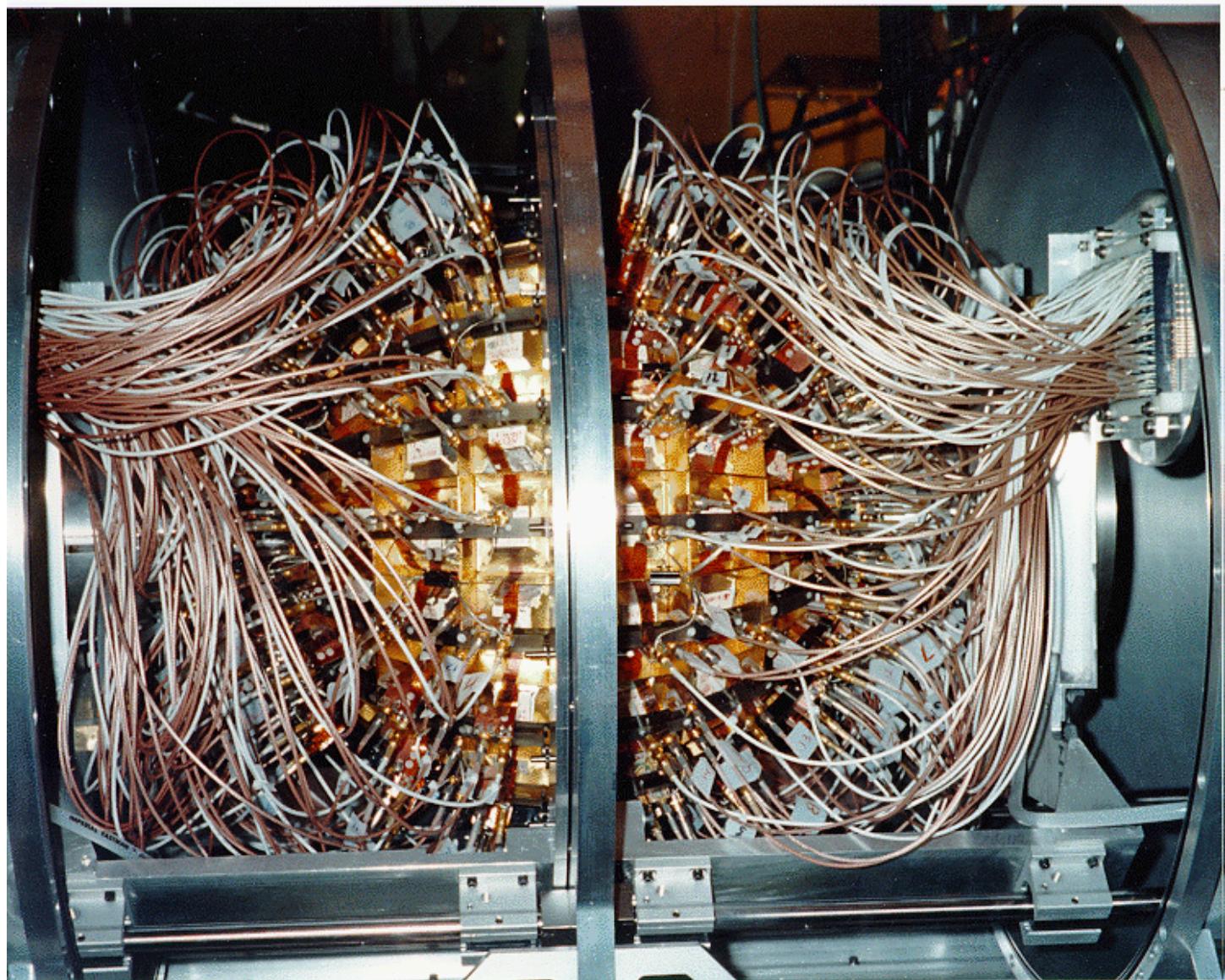
Experiment 899 measured pion-induced fission fragment cross sections for multiplicities of up to four with Solid State Nuclear Track Detectors (SSNTD) directly in beams of  $\pi^-$  from 500 to 1460 MeV kinetic energy. A recent exposure at LAMPF measured fission cross sections but not multiplicities at negative pion energies of 350 and 500MeV. Targets of several heavy elements were exposed to each of four AGS beam energies within the same stack of detectors.

High multiplicity events have been found to be rare in early analyses, but a marked forward peaking of fission events shows linear momentum transfer from the pion beam.

**EXPERIMENT 900**

**Home Page •** <http://www.iucf.indiana.edu/Experiments/ISIS/isis.html>

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Full View of the ISiS Detector

**EXPERIMENT 900 - ENERGY DISSIPATION AND MULTIFRAGMENTATION IN  
H + A REACTIONS BETWEEN 2 AND 24 GEV/C**

**Spokesmen: K. Kwiatkowski and V. E. Viola**

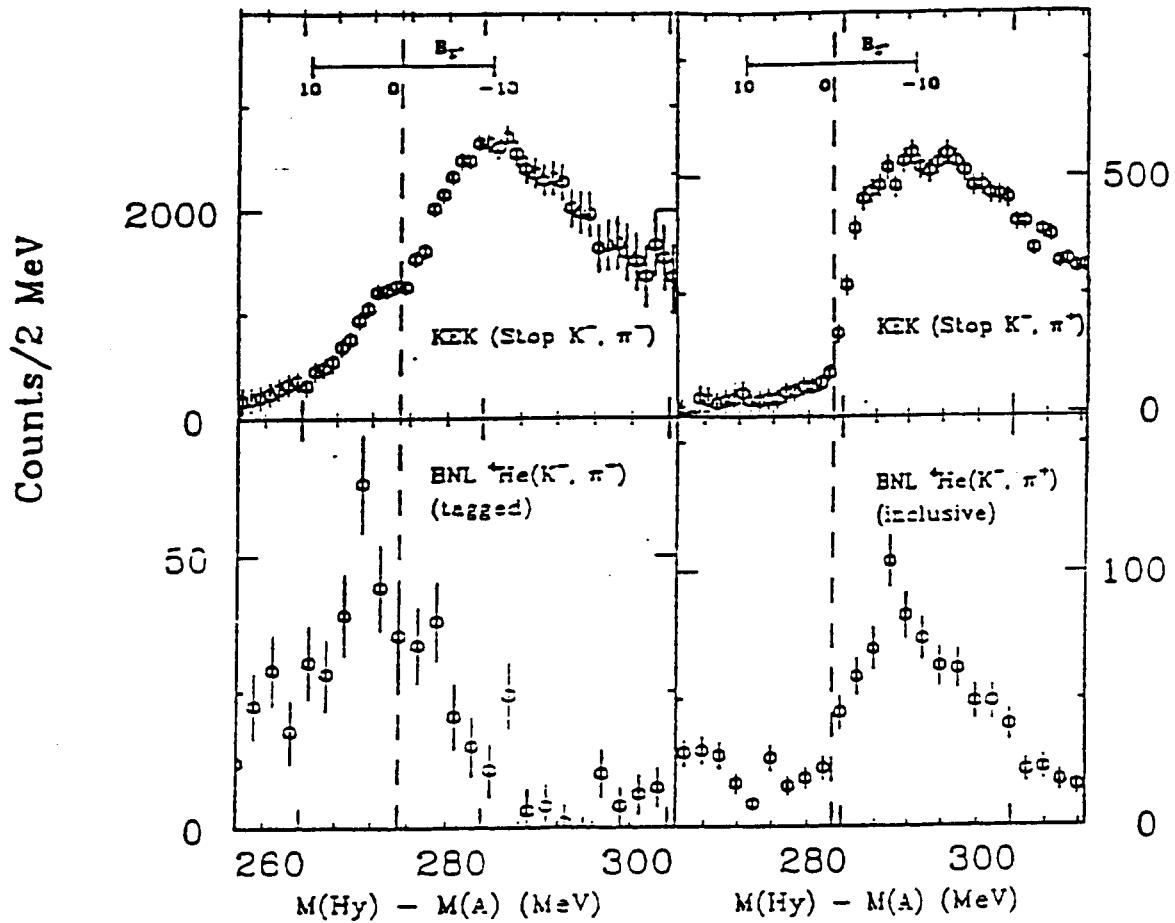
- **Argonne National Laboratory** - B. Back
- **Brookhaven National Laboratory** - S. Gushue, L. P. Remsberg
- **Indiana University** - W.-Ch Hsi, K. Kwiatkowski, T. Lefort, V. E. Viola, N. R. Yoder
- **Los Alamos National Laboratory** - D. S. Bracken, K. B. Morley
- **Simon Fraser University** - R. Korteling
- **Texas A&M University** - F. Gimeno-Nogues, E. Ramakrishnan, D. Rowland, S. J. Yennello
- **Warsaw University** - L. Pienkowski
- **University of Maryland** - H. Breuer

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Exclusive studies of target fragmentation in 2 - 24 GeV/c hadron ( $p$ ,  $\bar{p}$  and  $\pi^\pm$ )-induced reactions have started. Measurements are performed with the Indiana Silicon Sphere  $4\pi$  detector array, capable of identifying H and He isotopes and  $Z = 3 - 20$  fragments for target rapidity ejectiles over a wide dynamic range. The primary physics objectives are twofold: (1) to improve the understanding of energy dissipation phenomena for central collisions in the  $h + A$  reaction at relativistic energies, and (2) to examine the decay modes of hot nuclear matter excited by simple hadron probes. The bombarding energy regime is chosen to overlap the region in which previous inclusive measurements at AGS have been interpreted in terms of a liquid-gas phase transition in hot finite nuclei. It is in this energy region that the excitation of  $\Delta$ ,  $N^*$  and higher resonances provide an effective means of dissipating projectile energy into internal excitation energy of the target nucleus. Thus, these data will place fresh constraints on the new generation of transport codes, as well as current models of multifragmentation. During the 1996 proton cycle, studies were successfully completed on the  $p + {}^{197}\text{Au}$  system at 6.0, 10.0, 12.0 and 14.6 GeV/c and  $\pi^\pm + {}^{197}\text{Au}$  at 5.0, 9.2 and 11.0 GeV/c. These measurements demonstrated an independence of energy deposition on projectile momentum and type for these reactions. In 1998 it is intended to measure the 7 GeV/c  $p + {}^{197}\text{Au}$  reaction to search for enhanced energy deposition with antiproton beams.

## EXPERIMENT 905

Home Page • <http://www.phy.bnl.gov/~bnlhyp/e905.html>



A comparison of the in-flight (BNL) observations of the  $\Sigma$ -structure in  ${}^4\text{He}$  and the stopped kaon experiments at KEK. In both sets, the structure is present in  $(\bar{K}^-, \pi^-)$  reactions, but not for  $(\bar{K}^-, \pi^+)$ .

**EXPERIMENT 905 - SEARCH FOR A HYPERNUCLEAR BOUND STATE IN  $^4\text{He}$  ( $\text{K}^-$ ,  $\pi^\pm$ ) REACTIONS**

**Spokesman: T. Nagae**

- **Brookhaven National Laboratory** - R. E. Chrien, A. Rusek, R. Sutter
- **George Washington University** - W. Briscoe
- **Hampton University** - W. Naing
- **INS-University of Tokyo** - T. Fukuda, T. Miyachi, T. Nagae, J. Nakano, H. Outa, T. Tamagawa,
- **North Carolina A&T** - R. Sawafta
- **Zagreb University** - M. Planinic
- **University of Houston** - T. Empl, E. V. Hungerford
- **University of North Carolina** - K. Johnston, C. Neerman
- **University of Tokyo** - R. S. Hayano, K. Kubota, Y. Shimizu, H. Tamura

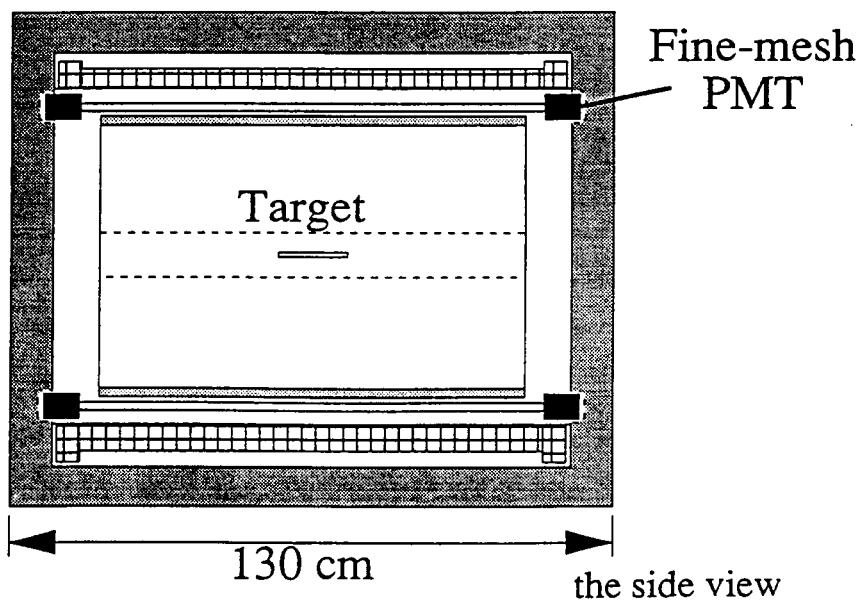
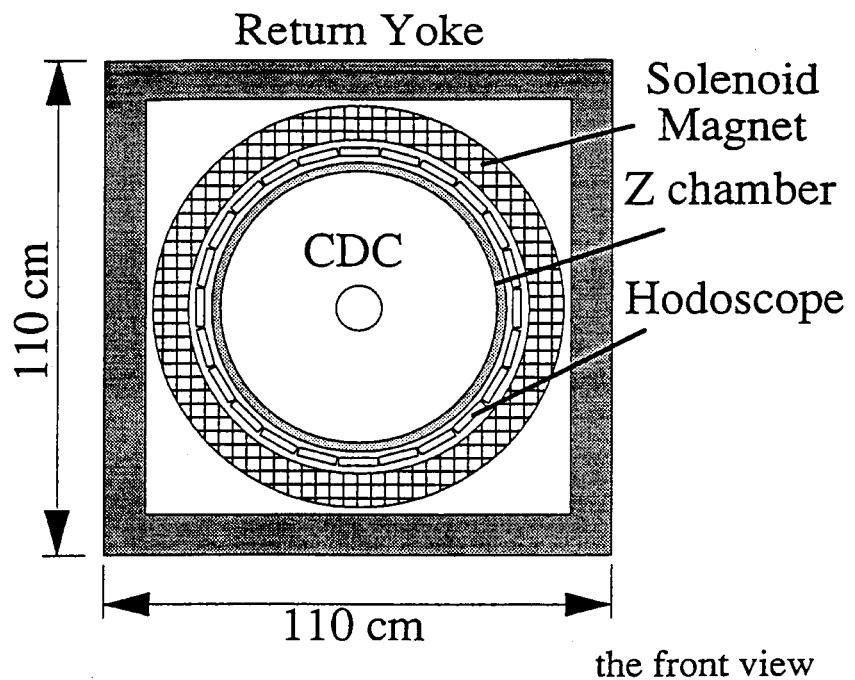
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The evidence for the existence of  $\Sigma$  (bound)-nuclei derives from three experiments: the first in a  $^4\text{He}$  bubble chamber at the AGS, the second at KEK with stopped  $\text{K}^-$  in  $^4\text{He}$ , and the third, BNL experiment E774. The purpose of E905 is to remeasure helium, using in-flight reactions to verify the existence of a bound state and to obtain the binding energy and width with high precision. This will be accomplished by making use of experience gained in BNL's E774 and E887 to get better control of systematic errors, suppress backgrounds due to electrons and muons and to obtain increased statistics. The precise measurement of the position and width of the postulated bound state may allow a definite allocation of the structure observed in these experiments to a bound state or to a threshold cusp, which is an alternative explanation. The precise measurement of the  $\Sigma$ -production cross sections in the bound and unbound regions will allow a choice between competing model explanations.

## EXPERIMENT 906

Home Page • <http://www.phy.bnl.gov/~bnlhyp/t.html>

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**EXPERIMENT 906 - EXPERIMENT TO DETECT DOUBLE- $\Lambda$  HYPERNUCLEI  
BY OBSERVING CHARACTERISTIC  $\pi^-$  MESONIC DECAYS**

**Spokesmen: R. E. Chrien, A. Rusek, T. Fukuda**

- **Brookhaven National Laboratory** - R. E. Chrien, M. May, P. Pile, A. Rusek, R. Sutter
- **Carnegie-Mellon University** - A. Berdoz, D. Carman, G. B. Franklin, B. P. Quinn, R. A. Schumacher
- **Gifu University** - M. Hanabata, K. Nakazawa
- **INR-Russia** - M. Prohvatilov, V. Rasin
- **INS-University of Tokyo** - J. Ahn, H. Akikawa, T. Fukuda, K. Kubota, T. Myuchi, T. Nagae, J. Nakano, K. Omata, H. Outa, M. Sekimoto, T. Tamagawa, H. Tamura, K. Tanida
- **Kyoto University** - K. Imai, K. Yamamoto, M. Yosoi
- **Kyoto-Sangyo University** - K. Okada, T. Kishimoto, F. Takeutchi
- **North Carolina A&T University** - R. Sawafta
- **Osaka University** - S. Ajimura, T. Kishimoto
- **Temple University** - E. Meziani
- **University of Freiburg** - H. Fischer, J. Franz, K. Konigsmann, H. Schmitt
- **University of New Mexico** - B. Bassalleck, H. Fischer, J. Lowe, D. M. Wolfe

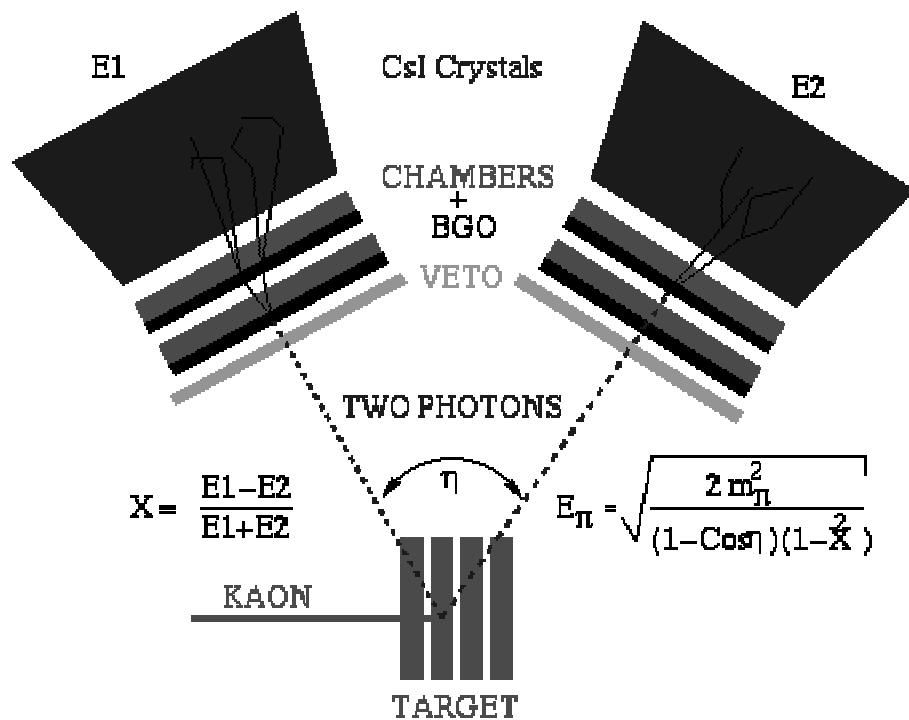
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The experimenters propose a new way to produce and to identify several hundred double- $\Lambda$  hypernuclei by observing two (successive) mesonic-decay pions with about 1.7 MeV resolution. The rate is larger by two orders of magnitude than other experiments done so far and will enable us to open a new spectroscopy of double- $\Lambda$  hypernuclei.

Double- $\Lambda$  hypernuclei will be produced at the ( $K^-, K^+$ ) reaction point through multi-step processes and successive mesonic-decay pions will be detected by a cylindrical detector system and solenoidal magnetic spectrometer (CDS) surrounding the target. The 2 GeV/c kaon beam line and the same experimental setup used for E813 and E836 (with some minor modifications), will be used for this experiment.

## EXPERIMENT 907

Home Page • <http://bart.phys.uh.edu/~mep/E907.html>



The above picture shows the conceptual setup of the experiment.

**EXPERIMENT 907 - INVESTIGATION OF LIGHT HYPERNUCLEI USING THE  
( $K^-$  STOP,  $\pi^0$ ) REACTION**

**Spokesmen: E. Hungerford and Jen-Chieh Peng**

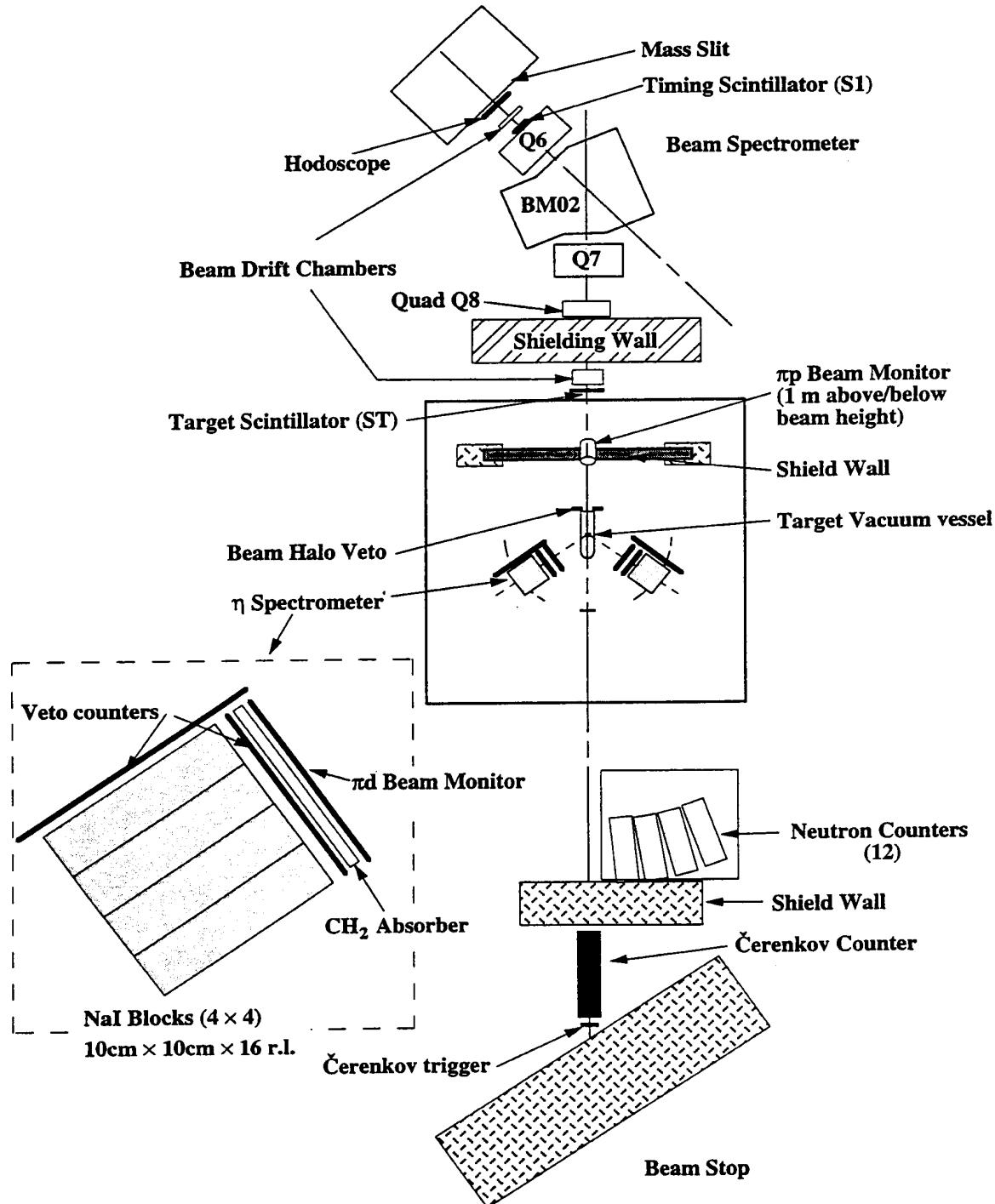
- **Arizona State University** - J. R. Comfort, C. Gauland
- **Brookhaven National Laboratory** - R. E. Chrien, J. Gerald, M. May, P. H. Pile, A. Rusek, R. Sutter, W. B. Tippens
- **Carnegie-Mellon University** - G. B. Franklin, B. Quinn
- **CEBAF** - L. Tang
- **George Washington University** - W. Briscoe
- **Los Alamos National Laboratory** - J. Amann, D. Boudrie, C. Edwards, B. F. Gibson, C. Morris, J. O'Donnell, J-C. Peng, A. Thiessen
- **Louisiana Tech University** - M. Barakat, K. Johnston
- **North Carolina A&T** - R. Sawafta
- **R. Boskovic Institute** - I. Supek
- **Tohoku University** - O. Hashimoto
- **University of California at Los Angeles** - B. Nefkens
- **University of Colorado** - G. A. Peterson
- **University of Houston** - M. Ahmed, X. Cui, A. Empl, E. V. Hungerford, A. Lan, B. Mayes, L. Pinsky
- **University of Kentucky** - V. Zeps
- **University of Maryland** - P. G. Roos
- **University of Minnesota** - D. Dehnhard
- **University of Texas at Austin** - G. Glass, C. Fred Moore, H. Ward
- **University of Zagreb** - D. Androic, M. Furic, T. Petkovic, M. Planinic

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The experimenters propose to use the combination of a multi-layer active target and the Neutral Meson Spectrometer (NMS) to detect  $\pi^0$ 's in order to study hypernuclear physics. The reaction to be used is ( $K^-$  STOP,  $\pi^0$ ), with stopping  $K^-$  obtained from the LESB-II(C) beam line at the AGS. The NMS will be moved from LAMPF to BNL for this experiment.

## EXPERIMENT 909

Home Page • <http://www.ucla5.phy.bnl.gov/E909/e909.html>



**EXPERIMENT 909 - ETA PRODUCTION AT THRESHOLD IN THE REACTIONS  $\pi^- p \rightarrow \eta n$  AND  $K^- p \rightarrow \Lambda \eta$**

**SPOKESMEN: W. J. BRISCOE AND W. B. TIPPENS**

- **Abilene Christian University** - L. D. Isenhower, M. E. Sadler
- **Brookhaven National Laboratory** - S. Bart, R. E. Chrien, R. Sawafta, D. Sutter
- **George Washington University** - C. Bennhold, W. J. Briscoe, T. W. Morrison, Z. Papandreou, S. Philips, R. Pratt, J. Prokop,
- **Joint Institute for Nuclear Research-Dubna** - A. Efendiev
- **PNPI, Gatchina** - V. Abaev, V. Bekrenev, N. Kozlenko, S. Kruglov
- **Rudjer Boskovic Institute** - A. Marusic, I. Šlaus
- **University of California-Los Angeles** - M. Clajus, S. McDonald, T. Moriwaki, B. M. K. Nefkens, W. B. Tippens, D. White

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The threshold for  $\eta$  production in the reactions  $\pi^- p \rightarrow \eta n$  and  $K^- p \rightarrow \Lambda \eta$  is close to the mass of the  $S_{11}(N^*(1535)$  and  $S_{11} N^*(1535)$  and  $S_{01}(\Lambda^* 1670)$  resonances, respectively. The cross section for  $\eta$  production in both reactions is unexpectedly large as are other threshold production cross sections. Better quality data, particularly angular distributions which are currently lacking, in both the  $K^- p$  and  $\pi^- p$  reactions are needed to understand the role of these resonances near the  $\eta$  threshold. There is a factor of four discrepancy in the determination of the  $\eta N$  scattering length and the  $\eta \Lambda$  scattering length is unknown due to a lack of precise threshold cross section data. New, precision data at threshold would allow better determinations of these scattering lengths.

The experimenters propose to measure total cross section, as well as angular distributions for  $\eta$  production in both of these reactions from threshold ( $P_\pi = 685$  MeV/c, and  $P_K = 723$  MeV/c) up to 760 MeV/c. The  $\eta$  particles are detected via the  $2\gamma$  decay mode using the improved  $\eta$  spectrometer currently in operation on the C8 beam line.

**EXPERIMENT 913**

**Home Page •** [http://ucla5.phy.bnl.gov/htdocs/e913-914\\_new/e913-914.html](http://ucla5.phy.bnl.gov/htdocs/e913-914_new/e913-914.html)

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**EXPERIMENT 913 - BARYON SPECTROSCOPY WITH THE CRYSTAL BALL**

**Spokesman: M. E. Sadler, H. Spinka, W. B. Tippens**

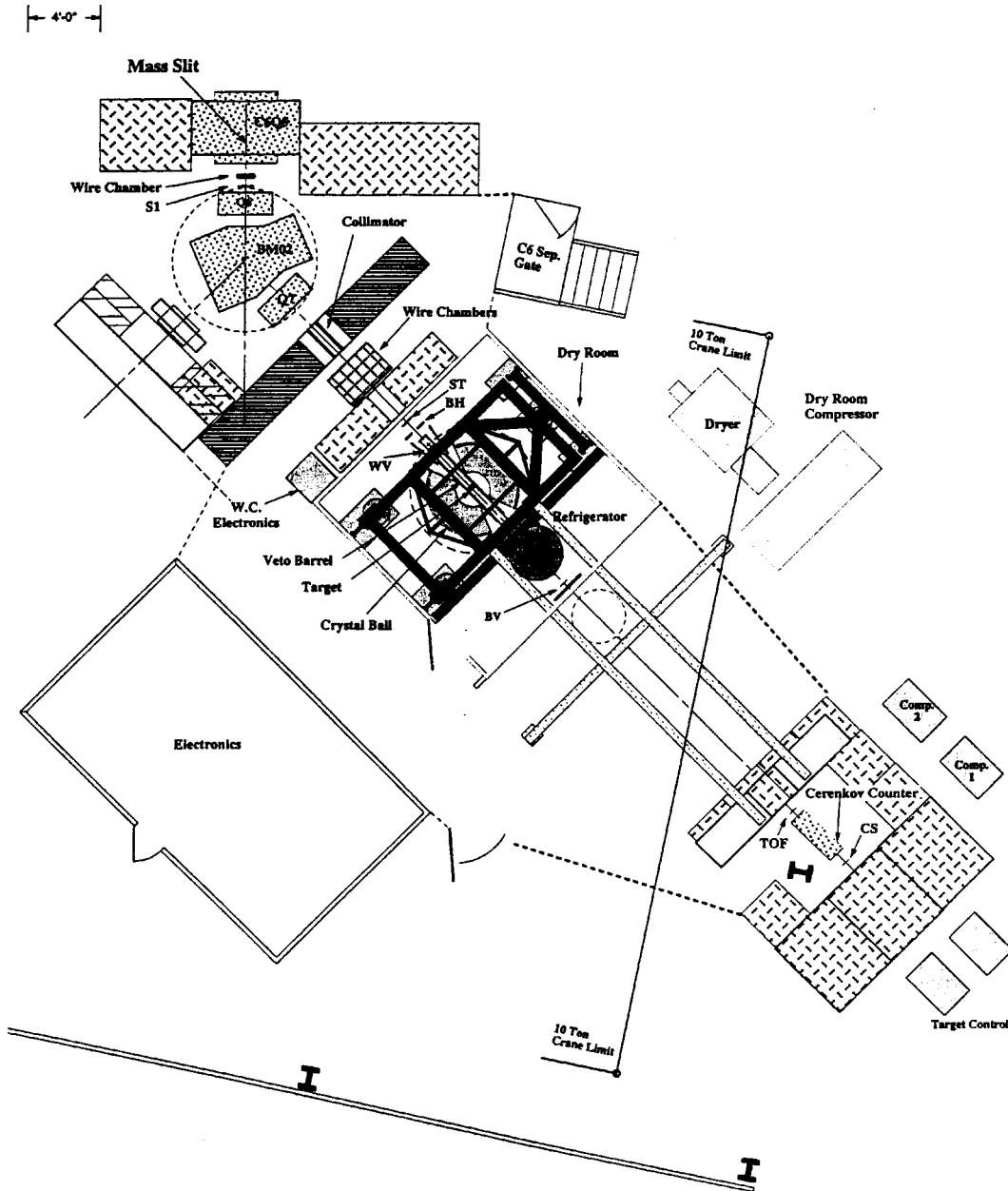
- **Abilene Christian University** - R. Bagga, B. Draper, J. Huddleston, D. Isenhower, Z. Mulkey, M. Sadler
- **Argonne National Laboratory** - T. Kasprzyk, H. Spinka
- **Arizona State University** - J. Comfort, K. Craig, A. Ramirez
- **Brookhaven National Laboratory** - T. Kycia
- **George Washington University** - W. J. Briscoe, A. Shafi
- **Kent State University** - D. M. Manley
- **Petersburg Nuclear Physics Institute-Gatchina** - V. Abaev, V. Bekrenev, S. Kruglov, A. Kulbardis, I. Lopatin, A. Starostin
- **Rudjer Boskovic Institute** - I. Šlaus, I. Supek
- **Valparaiso University** - A. Gibson, D. Grosnick, D.D. Koetke, R. Manweiler, P. Nord, S. Stanislaus
- **University of California-Los Angeles** - M. Clajus, S. McDonald, A. Marusic, B.M.K. Nefkens, M. Pulver, W. B. Tippens
- **University of Colorado** - J. Patterson, J. Peterson
- **Universit at Karlsruhe** - H. Staudenmaier
- **University of Regina** - N. Knecht, G. Lolos, Z. Papandreou

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This is a comprehensive experimental program in baryon spectroscopy using the SLAC Crystal Ball detector to make precision measurements of total and differential cross sections for neutral final states in  $\pi^- p$  interactions using pion beams in the momentum range 0.4 - 1.9 GeV/c. The angular distributions of all the neutral final states such as  $\gamma n$ ,  $\pi^0$  are measured simultaneously. The purpose is to improve the mass, width, and neutral branching fractions for the  $N^*$  resonances in this energy region. The Crystal Ball detector is a nearly  $4\pi$  multi-photon spectrometer which is used to analyze events by reconstructing the invariant mass and, in conjunction with the measured beam momentum, the missing mass of the produced  $\gamma$  rays.

## EXPERIMENT 914

Home Page • <http://ucla5.phy.bnl.gov/htdocs/e913-914/e913-914.html>



## EXPERIMENT 914 - NEUTRAL HYPERON SPECTROSCOPY

**Spokesman: B.M.K. Nefkens, T. Kycia, S.P. Kruglov**

- **Abilene Christian University** - R. Bagga, B. Draper, J. Huddleston, D. Isenhower, Z. Mulkey, M. Sadler
- **Argonne National Laboratory** - T. Kasprzyk, H. Spinka
- **Arizona State University** - J. Comfort, K. Craig, A. Ramirez
- **Brookhaven National Laboratory** - T. Kycia
- **George Washington University** - W. J. Briscoe, A. Shafi
- **Kent State University** - D. M. Manley
- **Petersburg Nuclear Physics Institute-Gatchina** - V. Abaev, V. Bekrenev, S. Kruglov, A. Kulbardis, I. Lopatin, A. Starostin
- **Rudjer Boskovic Institute** - I. Šlaus, I. Supek
- **Valparaiso University** - A. Gibson, D. Grosnick, D.D. Koetke, R. Manweiler, P. Nord, S. Stanislaus
- **University of California-Los Angeles** - M. Clajus, S. McDonald, A. Marusic, B.M.K. Nefkens, M. Pulver, W. B. Tippens
- **University of Colorado** - J. Patterson, J. Peterson
- **Universit at Karlsruhe** - H. Staudenmaier
- **University of Regina** - N. Knecht, G. Lolos, Z. Papandreou

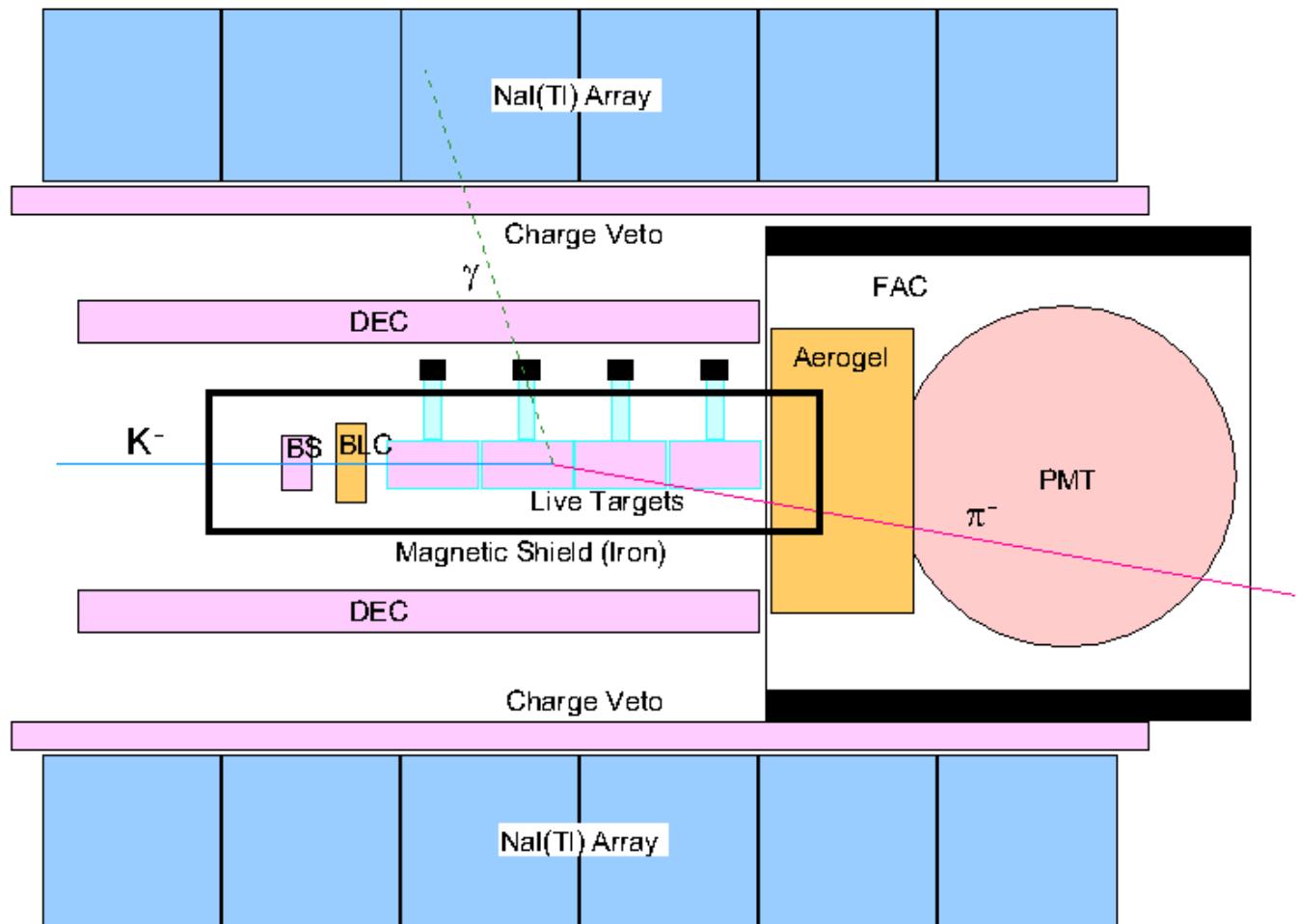
This experiment proposes to investigate the spectrum of  $\Lambda^*$  and  $\Sigma^*$  resonances via their neutral decays in the reactions:

$K^- P \rightarrow \Lambda \gamma$	600-1800 MeV/c ( $p_{lab}$ )
$K^- P \rightarrow \Lambda \pi^0$	"
$K^- P \rightarrow \Lambda 2\pi^0$	"
$K^- P \rightarrow \Lambda \eta$	720-1800 MeV/c ( $p_{lab}$ )
$K^- P \rightarrow \Sigma^0 \gamma$	600-1800 MeV/c ( $p_{lab}$ )
$K^- P \rightarrow \Sigma^0 \pi^0$	"
$K^- P \rightarrow \Sigma^0 2\pi^0$	"
$K^- P \rightarrow \Sigma^0 \eta$	890-1800 MeV/c ( $p_{lab}$ )

Measurements of total and differential cross sections of these reactions will be made simultaneously over the full angular range, using the Crystal Ball multi photon spectrometer and a LH2 target. The Crystal Ball has a 94% solid angle coverage and good energy and angular resolution. The incident beam momentum is varied in steps of 25-50 MeV/c from 600 MeV/c in the C-line to the maximum momentum of 1.8 GeV/c in the D-line.

## EXPERIMENT 929

Home Page • <http://ejsn.phys.sci.osaka-u.ac.jp/Kisimoto-e.html>



Schematic layout of the target region and the detector are shown.

**EXPERIMENT 929 - SPIN-ORBIT SPLITTING OF SINGLE  $\Lambda$  STATE STUDIED BY THE  $^{13}\text{C}(\text{K}^-, \pi^-\gamma)$  REACTION**

**SPOKESMAN: T. KISHIMOTO**

- **Brookhaven National Laboratory** - R. E. Chrien, M. May, P. Pile, A. Rusek, R. Sutter
- **Hampton University** - L. Tang
- **Manitoba University** - L. Lee
- **National Laboratory of High Energy Physics** - H. Noumi
- **North Carolina A&T State University** - R. Sawafta
- **Osaka University - Department of Physics** - S. Ajimura, H. Hayakawa, R. Hazama, T. Kishimoto, K. Morikubo, E. Sajai, R. Sato
- **Osaka University - Research Center for Nuclear Physics** - N. Kudomi, K. Kume, Y. Mizuno, M. Nomachi, K. Tamura
- **Tohoku University** - K. Maeda, T. Suda
- **University of Houston** - M. Ahmed, R. Barber, T. Empl, E. V. Hungerford, K. J. Lan, B. W. Mayes, M. Muerleilier, L. S. Pinsky, M. Youn
- **University of Tokyo - Department of Physics** - H. Tamura
- **University of Tokyo - Institute for Nuclear Study** - T. Fukuda, T. Nagae, J. Nakano, H. Outa, T. Tamagawa

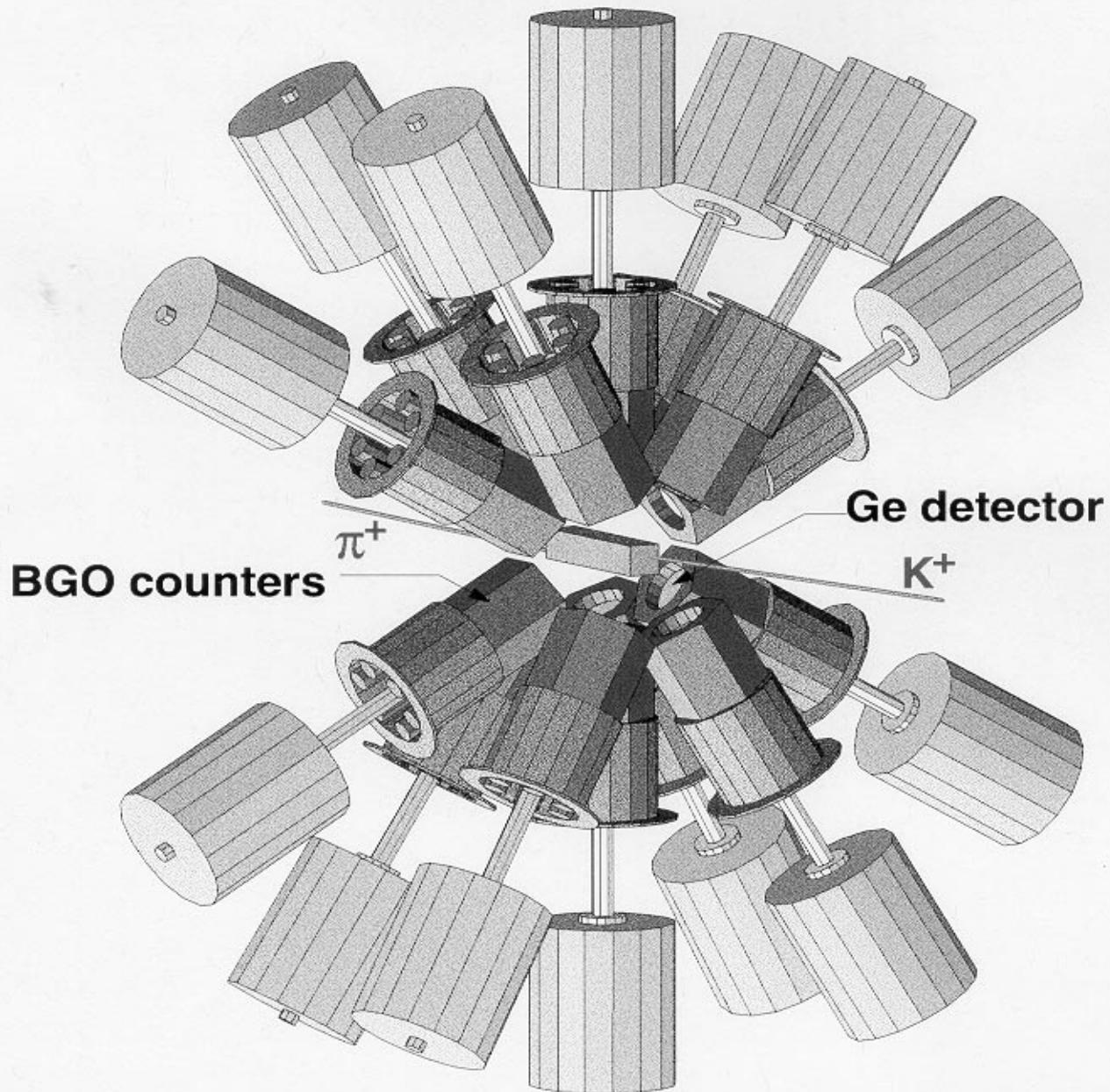
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The experimenters propose to measure the spin-orbit (ls) splitting of single  $\Lambda$  particle states in a hypernucleus.

**EXPERIMENT 930**

**Home Page** • <http://tkynx0.phys.s.u-tokyo.ac.jp/tamura/tamura.html>

# Ge Detector System for Hypernuclei



**EXPERIMENT 930 - HIGH-RESOLUTION  $\gamma$  SPECTROSCOPY OF HYPERNUCLEI  
USING LARGE-ACCEPTANCE GERMANIUM DETECTOR**

**SPOKESMAN: H. TAMURA**

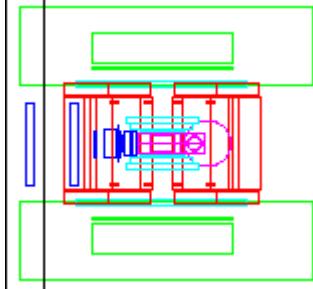
- **Brookhaven National Laboratory** - R. E. Chrien, M. May, P. Pile, A. Rusek
- **Hampton University** - L. Tang
- **KEK** - T. Fukuda, T. Nagae, H. Noumi, H. Outa
- **North Carolina A&T University** - R. Sawafta
- **Osaka University** - S. Ajimura, T. Kishimoto
- **Tohoku University** - O. Hashimoto, H. Tamura, T. Takehashi
- **University of Tokyo - Department of Physics** - T. Ishikawa, K. Tanida

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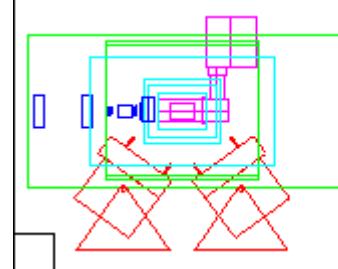
The experimenters propose a high-resolution  $\gamma$ -ray spectroscopy measurement of several light  $\Lambda$  hypernuclei employing a large-acceptance germanium detector system which is being constructed in Japan.  $\Lambda$  hypernuclei are produced by the ( $K^-, \pi^-$ ) reaction and their  $\gamma$  transitions are detected in coincidence. They will use  $K^-$  beam at C6 beam line together with the present spectrometer. The aim is to determine  $\Lambda N$  spin-dependent interactions through  $\gamma$  spectroscopy of some light hypernuclei. Data will be taken with  ${}^9Be$ ,  ${}^{16}O$ ,  ${}^{12}C$  and  ${}^7Li$  targets and to study  $\gamma$  transitions of  ${}^{15}_\Lambda N$ ,  ${}^9_\Lambda Be$ ,  ${}^{16}_\Lambda O$ ,  ${}^{12}_\Lambda C$ ,  ${}^7_\Lambda Li$ , which will give information on the spin-spin, spin-orbit, and tensor interactions between  $\Lambda$  and nucleon.

## EXPERIMENT 931

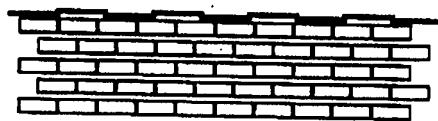
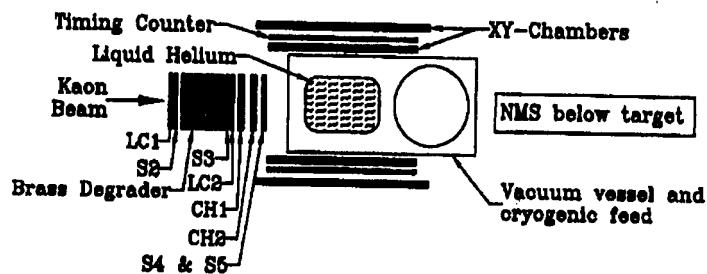
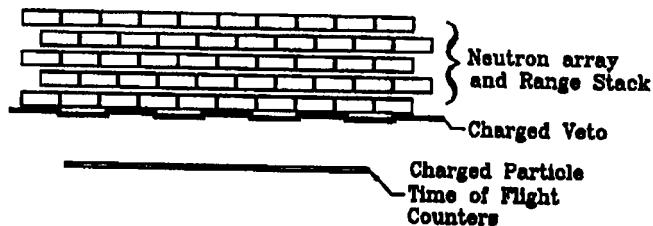
Home Page • <http://bart.phys.uh.edu/~mep/e931/>



Top View of Experiment



Side View of Experiment



Experimental Layout for the weak decay of  $\Lambda^0 \rightarrow p + e^- + \bar{\nu}_e$  measurement.

The beamline elements are labeled according to their type; S2-5 are scintillator elements, LC designates lucite Cherenkov detectors for K/ $\pi$  separation, and CH designates tracking chambers to determine the direction of the incoming kaon.

**EXPERIMENT 931 - STUDY OF THE  $\Delta I = \frac{1}{2}$  RULE IN THE WEAK DECAY OF S-SHELL HYPERNUCLEI**

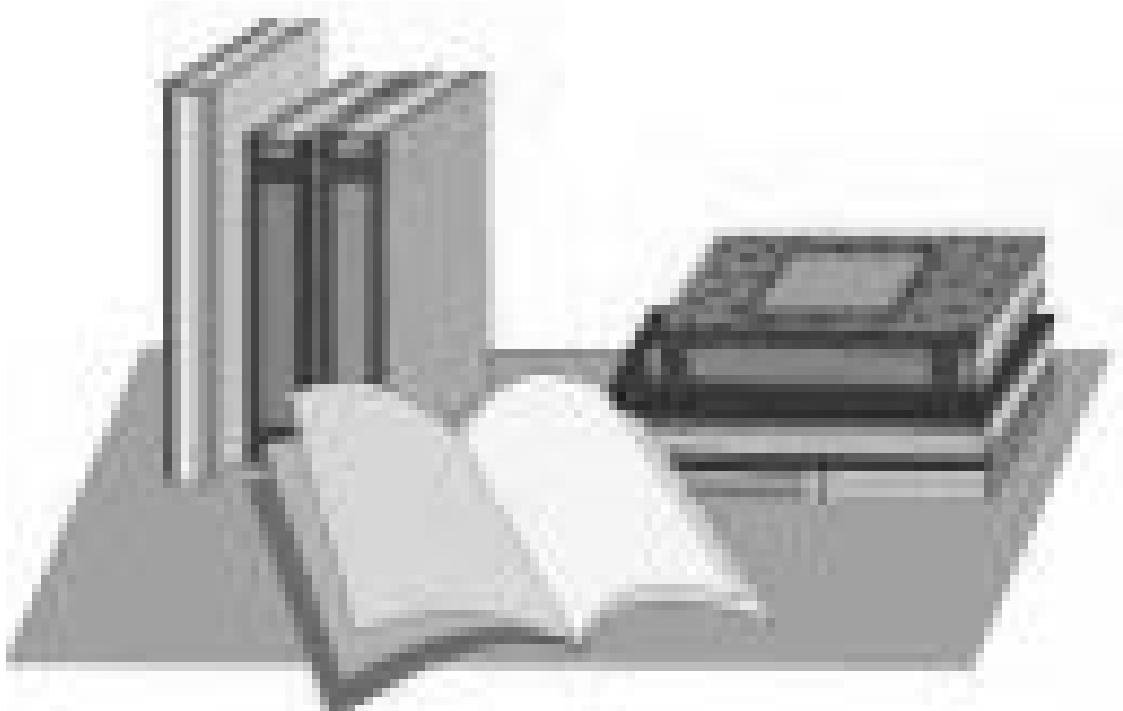
**SPOKESMAN: D. DEHNHARD, E. HUNGERFORD, V. ZEPS**

- **Arizona State University** - J. R. Comfort, C. Gauland
- **Brookhaven National Laboratory** - R. E. Chrien, J. Gerald, M. May, P. H. Pile, A. Rusek, R. Sutter, W. B. Tippens
- **Carnegie-Mellon University** - G. B. Franklin, B. Quinn
- **CEBAF** - L. Tang
- **George Washington University** - W. Briscoe
- **Los Alamos National Laboratory** - J. Amann, D. Boudrie, C. Edwards, B. F. Gibson, C. Morris, J. O'Donnell, J-C. Peng, A. Thiessen
- **Louisiana Tech University** - M. Barakat, K. Johnston
- **North Carolina A&T** - R. Sawafta
- **R. Boskovic Institute** - I. Supek
- **Tohoku University** - O. Hashimoto
- **University of California at Los Angeles** - B. Nefkens
- **University of Colorado** - G. A. Peterson
- **University of Houston** - M. Ahmed, X. Cui, A. Empl, E. V. Hungerford, A. Lan, B. Mayes, L. Pinsky
- **University of Kentucky** - V. Zeps
- **University of Maryland** - P. G. Roos
- **University of Minnesota** - D. Dehnhard
- **University of Texas at Austin** - G. Glass, C. Fred Moore, H. Ward
- **University of Zagreb** - D. Androic, M. Furic, T. Petkovic, M. Planinic

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This experiment addresses an unresolved, fundamental question of “why” and “when” to apply the  $\Delta I = \frac{1}{2}$  rule to the weak decay of strange hadrons. An opportunity now exists to determine if this apparently universal rule applies to the non-mesonic weak decay of a  $\Delta$ , by studying particle emission from an important problem which can only be addressed through the coupling of the NMS spectrometer to the C8 beam line.

# *List of Publications of AGS Experiments*



## Publications - AGS Experiments 1982 - 1999

*This listing was originally prepared using the SLAC data base SPIRES; we now rely on the experimenters themselves to supply us with information. It is easy to miss publications in such a wide search and we apologize for any left out or misidentified. Please let us know about these as well as keeping us posted on your recent publications of AGS experiments.*

- 774 R.E. Chrien, E.V. Hungerford, and T. Kishimoto, *Continuum effects and the interpretation of  $\Sigma$ -Hypernuclei*. Phys. Rev. C35, 1589 (1987).
- 781 R. E. Chrien, et al., *Search for radiative transitions in the hypernucleus  ${}^{10}B$* , Published in Phys. Rev. C41, 1062-1074 (1990).
- M. May et al.,  $p \rightarrow s_\Lambda$  gamma ray transition in  ${}^{13}\text{C}$ , Phys. Rev. Lett. 78, 4343-4346 (1997).
- 788 J.J. Szymanski, *Weak Decay of  $\Lambda^0$  Hypernuclei*, Proc. of the 2nd Conf. on the Intersections between Particle and Nuclear Physics, Lake Louise, Alberta, Canada, May 24, 1986.  
J.J. Szymanski, et al., Phys. Rev. C43, 849 (1991).
- 811 E.C. Booth, et al., *A study of radiative hyperon processes at Brookhaven*, XI International Conference on Particles and Nuclei, Kyoto, 20-24 April 1987.  
D.A. Whitehouse, et al., *Radiative kaon capture in hydrogen*, Bull. Am. Phys. Soc. 33, 1022 (1988).  
K.P. Gall, et al., *Radiative kaon capture in deuterium*, Bull. Am. Phys. Soc. 33, 1022 (1988)  
B.L. Roberts, et al.,  $\Sigma^+$  *Weak radiative decay*, Bull. Am. Phys. Soc. 33, 1022 (1988).  
B.L. Roberts, et al., *Radiative kaon capture and hyperon weak radiative decay*, Nucl. Phys. A479, 75c (1988).  
A.J. Noble, et al.,  $\Lambda$  and  $\Sigma^+$  *weak radiative decay*, Proc. of the Third Conference on the Intersection of Particle and Nuclear Physics, Rockport ME, 14-19 May, 1988, AIP Conf. Proc. 176, 842 (1988).  
E.K. McIntyre, et al., *Radiative kaon capture*, Proc. of the Third Conference on the Intersection of Particle and Nuclear Physics, Rockport ME, 14-19 May 1988, AIP Conference Proc. 176, 673 (1988).  
D. Horváth, et al., *Experimental study of radiative hyperon processes following kaon capture on the proton*, Int. Conf. on Mesons & Light Nuclei, Bedujné, Czechoslovakia, August 1988.  
E.K. McIntyre, et al., *Radiative kaon capture in hydrogen*, Excited Baryons 88, August 1988, RPI, Troy, N.Y.  
D. Horváth, et al., *Experimental study of radiative hyperon processes following kaon capture on the proton*, J. Phys. B, 160 (1989).  
D. Horváth, et al., *Radiative hyperon processes following kaon capture on protons*, International Seminar on Intermediate Energy Physics, Moscow, USSR, November 17-30, 1989.  
D. Horváth, et al., *Radiative hyperon processes following kaon capture on proton*, to be published in the proceedings of the Third International Symposium on Pion-Nucleon and Nucleon-Nucleon Physics, Gatchina, USSR, April 1989.

- E.K. McIntyre, et al., *Radiative kaon capture in hydrogen*, Excited Baryons 1988, Proceedings ed. G. Adams, N.C. Mukhopadhyay and P. Stoler, World Scientific, 434-438 (1989).
- N.P. Hessey, et al., *A measurement of the branching ratio for the  $\Sigma^+ \rightarrow p\gamma$  decay*, Z. Physik, C42, 175 (1989).
- D.A. Whitehouse, et al., *Radiative kaon capture at rest on the proton*, Phys. Rev. Lett. 63, 1352 (1989).
- B.L. Roberts, et al., *Radiative hyperon processes*, Nuova Cim. 102 A, N. 1, 145 (1989).
- B.L. Roberts, *Radiative hyperon decay*, Excited Baryons 1988, Proceedings ed. G. Adams, N.C. Mukhopadhyay and P. Stoler, World Scientific, 410-410 (1989).
- K.P. Gall, et al., *Radiative kaon capture on deuterium and the  $\Lambda n$  scattering lengths*, Phys. Rev. C, Rapid Comm., 42, R475 (1990).
- A.J. Noble, et al., *A study of the weak radiative decay  $\Lambda \rightarrow n\gamma$* , DPF90 Conference, Houston, January 1990, Bull. Am. Phys. Soc., 35, 1207 (1990).
- M.D. Hasinoff, et al., *The reaction  $\pi^- p \rightarrow \pi^0 \pi^0 n$  near threshold*, DPF90 Conference, Houston, Jan. 1990, Bull. Am. Phys. Soc. 35, 1209 (1990).
- B. Bassalleck, et al., *The weak radiative decay  $\Lambda \rightarrow n + \gamma$ , a status report from Brookhaven experiment 811*, contribution to the 18th INS Int. Symposium on Physics with High-Intensity Hadron Accelerators, Tokyo, March 14-16, 1990.
- K.D. Larson, et al., *A report on the measurement of the weak radiative decay  $\Lambda \rightarrow n + \gamma$* , Proceedings of the International Conference on Particles and Nuclei, MIT, June 1990, abstract V-29.
- B.L. Roberts, et al., *Weak radiative hyperon decays*, Int. Symp. on Weak Interactions and Neutrino Physics, Ginosar, Israel, April 1989, Nucl. Phys. B13, 449 (1990).
- A.J. Noble, et al., *Measurement of the  $\Lambda \rightarrow n\gamma$  branching ratio*, Phys. Rev. Lett. 69, 410 (1992).
- 813** P. D. Barnes (for the E813 collaboration), *Search for the H particle: its production and weak decay*, LA-UR-92-535-mc (microfiche), Dec., 1991. 14 pp submitted to Intl. Symp. On Hypernuclear and Strange Particle Physics, Simoda, Japan, Dec. 9-12, 1991, published in Nucl. Phys. A547:3c-16c, 1992.
- P.H. Pile, et al., *A New 1-2 GeV/c separated beam for BNL*. Nucl. Inst. and Methods in Physics Research A321 (1992) 48-58.
- B.P. Quinn et. al., *The search for the H dibaryon with the BNL 2.0 GeV/c kaon beam*, Invited Talk presented at the 4th Conf. on the Intersections between Particle and Nuclear Physics, May 24--29, 1991, Tucson, Arizona. AIP conference proceedings 243, p. 579-581 (1992).
- V. Sum, et al., *A Time-of-flight array for 1 to 2 GeV/c particles*. Nucl Inst. and Methods in Physics Research, A326 489-495, North-Holland (1993).
- Toru Iijima, *H-Dibaryon Search in the Reaction  $\Xi^- d \rightarrow Hn$  at rest by measuring the neutron in coincidence with the  $\Xi$* , Memoirs of the Faculty of Science, Kyoto University, Series A of Physics, Astrophysics, Geophysics and Chemistry, Vol. XXXIX, No. 2, Article 1, 1995.
- F. Merrill, *H-dibaryon search via  $\Xi^-$  capture on the deuteron*, UMI-96-05051-mc(microfiche), June 1995, 213 pp, Ph.D. Thesis (Carnegie Mellon U.).

## Publications

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Robert E. Chrien, *H particle searches at Brookhaven*. Proc. Int. Conf. Quark Lepton Nuclear Physics, Osaka, Japan, May 20-23, 1997.

- 818** J. H. Lee et al., *Spin parity analysis of the  $F_1(1285) \pi^-$  system in the reaction  $\pi^- \rightarrow f_1(1285) \pi^- p$  at 1 GeV/c*, Published in Phys. Lett. B323, 227-232 (1994).
- 820** K. Johnston, et al., *Search for a strangeness-1 dibaryon below the sigma N threshold*, Published in Phys. Rev. C46, 1573-1576 (1992).
- 834** A. S. Carroll, et al, *Nuclear Transparency to Large-Angle pp Elastic Scattering*, Phys. Rev Lett., 61, 1698 (1988).
- 835** J. Alster, in Workshop on Nuclear Structure with Medium Energy Probes, Santa Fe, NM, 1988. AGS Experiment 835 Collaboration, *Kaon-nucleus total cross sections*, PANIC XII International Conf. on Particles and Nuclei, Cambridge, MA. June 25-29, 1990.
- Y. Mardor, et al.,  *$K^+$  total cross sections as a test for nucleon "swelling."* Phys. Rev. Lett. 65, 2110-13 (1990).
- Y. Mardor,  *$K^+$  Total cross sections and swelling in nuclei*. Thesis submitted toward the M.Sc. degree in at Tel-Aviv University (1990).
- J. Alster (representing collaboration).  *$K^+$ -nucleus total cross section experiment and nuclear medium effects*. Nucl. Phys. A547, 321c-30c (1992).
- R.A. Krauss et, al.,  *$K^+$  total cross sections on  $^{12}C$  and medium effects in nuclei*, Phys. Rev. C 46, 655,1992.
- R. Sawafta (Exp. 835 Collaboration). *The  $K^+$  meson as a probe of the nuclear medium*. Invited talk. Fourth Conference on the Intersections between Particle and Nuclear Physics, Tucson, Arizona, May 24-29, 1991, W.T.H. van Oers, Editor, AIP Conf. Series 243, 582-7 (1992).
- R.E. Chrien, *The  $K^+$  as a probe of nuclear medium effects*. Invited talk. Workshop on Strangeness in Nuclei, Krakow, Poland, May 5-7, 1992. To appear in Nukleonika.
- R. Sawafta, et al., *The influence of the nuclear medium on  $K^+$  total cross sections*. Phys. Rev. Lett. B307, 293 (1993).
- 836** R. W. Stotzer, et al., *Search for the H-dibaryon in  $^3He (K, K^+)Hn$* , Phys. Rev. Letts. 78, 3636 (1997).
- 838** C. White, et al., Phys. Rev. D 49, 58 (1994). *Comparison of 20 exclusive reactions at large t*.
- 850** J.A. Appel, J. Botts, G. Bunce, G. Farrar, S. Pordes. Color Transparency Study Group.BNL-45319.
- A. Carroll and T. Londergan, *Hadron dynamics - working group summary*, future directions in particle and nuclear particle physics at multi-GeV hadron beam facilities (1993).
- J. Y. Wu, et al., *The EVA trigger: transverse momentum selection in a solenoid*, NIM A349 (1994).
- T. Mardor, et al., *Measurement of quasi-elastic  $^{12}C(p, 2p)$  scattering at high momentum transfer*, submitted to Phys. Rev. Lett (1997).
- J. Aclander, et al., *A direct measurement of short range NN correlations in nuclei via the reactive  $^{12}C(p, 2p + h)$* , submitted to Phys. Rev Lett (1997).
- A. S. Carroll, et al., *Measurement of color transparency by C (p, 2p) reaction at large momentum transfer*, HADRON97

J. Aclander, et al., *Short range NN correlations: a direct measurement*, HADRON97 conf., BNL, Ed. S-U Chung (1997).

T. Mardor, et al., *High  $p_t$  quasi-exclusive scattering with resonance production*, 6th conf. On Intersection of Particle and Nuclear Physics (1997).

T. Mardor, et al., *Quasi-elastic hadronic scattering at high momentum transfer*, 6th conf., on Intersections of Particle and Nuclear Physics (1997).

**852** A. Dzierba and S. Tiege for the E852 Collaboration, *First results from the E852 tests of a 320-element lead-glass calorimeter*. AGS Users Newsletter June 24, 1992.

B.B. Brabson, et al., *A study of two prototype lead glass electromagnetic calorimeters*. Nucl. Instr. & Meth. A332, 419-443 (1993).

A.R. Dzierba, *Meson spectroscopy with  $\pi$  and K Beams*. To appear in the Proceedings of the Workshop on Future Directions in Particle and Nuclear Physics at Multi-GeV Facilities, Brookhaven National Laboratory, March 4-6, 1993.

S. Y. Chung, *Search for exotic mesons, invited talk at Workshop on Hadron Physics at  $e^+e^-$  Colliders*, IHEP, Beijing, China, October 1994.

Z. Bar-Yam, et al., *A cylindrical drift chamber of novel design*. Nucl. Instrm. & Methods A312, 398-410 (1995).

Z. Bar-Yam, et al., *A scintillation detector of unique geometry*. Nuclear Instrum. & Methods, A357, 95-102 (1995).

S. U. Chung, *Summary of Hadron95*. Summary Talk given at the Sixth International Conference on Hadron Spectroscopy, Manchester, England, July 9-14, 1995. (BNL-QGS-95-91)

S. Teige, et al., *The Brookhaven National Laboratory E852 lead glass calorimeter system*, Proc. of 5th Intl. Conf. On Calorimetry in HEP, eds. H.A. gordon and D. Rueger, 161-166 (1995).

J. Dowd, *Properties of the reaction  $\pi^- p \rightarrow p \eta \pi^+ \pi^- \pi^-$  at 18 GeV/c*, Proc. of the 5th Intern. Conf. on Hadron Spectroscopy, Manchester, England, eds. M C. Birse, G. D. Lafferty, and J. A. McGovern, World Scientific, Singapore, (1996).

T. Adams, et al., *Resonance production in the reaction  $\pi^- p \rightarrow \eta \pi^- \pi^0 \pi^0$* , Proc. of the 5th Intl. Conf. on Hadron Spectroscopy, Manchester, England, eds. M. C. Birse, G. D. Lafferty, and J. A. McGovern, World Scientific, Singapore, 491-493 (1996).

T. Adams, et al., *Design and performance of a cesium iodide detector*. Nucl. Instrum. & Meth.A368, pp. 617-627 (1996).

B. B. Brabson, et al., *Study of the  $\pi^0 \pi^0$  system in  $\pi^- p$  interactions at 18 GeV/c*. Proc. of the V<sup>th</sup> Intern. Conf. on Hadron Spectroscopy, Manchester, England, eds. M C. Birse, G. D. Lafferty, and J. A. McGovern, World Scientific, Singapore, 494-496 (1996).

N. Cason, et al., *Study of the  $\eta \pi$ ,  $\eta \eta$ , and  $\eta' \pi$  systems in  $\pi^- p$  interactions at 18 GeV/c*. Proc. of the V<sup>th</sup> Intern. Conf. on Hadron Spectroscopy, Manchester, England, eds. M. C. Birse, G. D. Lafferty, and J. A. McGovern, World Scientific, Singapore, 55-62 (1996).

N. Cason, et al., *Study of the  $\eta \pi$ ,  $\eta \pi^0$ , and  $\pi^0 p$  interactions at 28 GeV/c*. Proc. HADRON 95 Conf., Manchester, England, June 1995, M. C. Birse, G. D. Lafferty, and J. A. McGovern, Editors, World Scientific, Singapore, pp. 55-61 (1996).

N. Cason, et al., *Study of  $\pi^+ \pi^- \pi^-$  interactions at 18 GeV/c*. (Presented by Dennis Weygand for the E852 collaboration.) Proc. HADRON 95 Conf., Manchester, England, June 1995, M. C. Birse, G. D. Lafferty, and J. A. McGovern, Editors, World Scientific, Singapore, pp. 241-247 (1996).

N. Cason, et al., *Observation of  $f_1(1285)\pi$  and  $\eta'(958)\pi$  in the reaction  $\pi p \rightarrow p \eta\pi^+\pi^-\pi^-$  at 18 GeV/c.* Presented by J. P. Dowd for the E852 collaboration.) Proc. HADRON 95 Conf., Manchester, England, June 1995, M. C. Birse, G. D. Lafferty, and J. A. McGovern, Editors, World Scientific, Singapore, pp. 497-499 (1996).

J. M. LoSecco, et al., *Search for exotic mesons in  $\pi p$  interactions at 18 GeV/c.* Proc. of the International School of Nuclear Physics, Erice, Italy, 1995. Amand Faessler, Editors, Pergamon, pp. 437-445 (1996).

J. Dowd, *Evidence for  $J^{PC} I^+$  exotic meson production in the eta piminus system,* proc. Of SLAC Summer School (1997).

D. R. Thompson, et al., *Evidence for exotic meson production in the reaction  $\pi^- \rightarrow \eta\pi p$  at 18 GeV/c,* Phys. Rev. Lett. Vol. 79, No. 9, p. 1630-1633, Sept. 1997.

R.R. Crittenden, et al., *A 3000 element lead glass electromagnetic calorimeter,* Nucl. Instr. Meth. A387, p. 377-394, (1997).

Z. Bar-Yam, et al., *A cylindrical drift chamber with azimuthal and axial position readout,* Nucl. Instr. Meth., A386, p. 235-248, (1997).

- 854** S. Ahmad, et al., *A silicon multiplicity detector system for an experiment on the interaction of antiprotons with nuclei at BNL.* IEEE Transaction on Nuclear Science, Vol. 39 (1992) 615-618.

S. Ahmad, et al., *Antiproton nucleus interactions at 5 to 9 GeV/c,* invited contribution at the Second Biennial Conference on Low Energy Antiproton Physics, Courmayeur, Aosta Valley, Italy, Sept. 14-19, 1992. The paper will be published in Nuclear Physics A.

- 857** J. Lowe, et al., *The reaction  $\pi^- p \rightarrow \pi^0 \pi^0 n$  near threshold and chiral symmetry breaking,* Proc. of the International Conference on Particles and Nuclei, MIT, June 1990, abstract III-3.

M.D. Hasinoff, et al., *The reaction  $\pi^- p \rightarrow \pi^0 \pi^0 n$  near threshold,* Bull. Am. Phys. Soc. 35, 1209 (1990).

J. Lowe, et al.,  *$\pi^- p \rightarrow \pi^0 \pi^0 n$  near threshold and chiral symmetry breaking,* Phys. Rev. C 44, 956 (1991).

J. Lowe, et al., *The reaction  $\pi^- p \rightarrow \pi^0 \pi^0 n$  near threshold and chiral symmetry breaking,*  $\pi N$  Newsletter No. 3, Sept. 1991, ed. R.E. Cutkosky, G. Höhler, W. Kluge, B.M.K. Nefkens, p. 47.

J. Lowe, et al., *The reaction  $\pi^- p \rightarrow \pi^0 \pi^0 n$  near threshold and chiral symmetry breaking,* Phys. Rev. C44, 956 (1991).

H. Burkhardt and J. Lowe, *The global analysis of  $\pi N \rightarrow \pi \pi N$  data,* Phys. Rev. Lett. 67, 2622 (1991).

J. Lowe, et al., *The reaction  $\pi^- p \rightarrow \pi^0 \pi^0 n$  near threshold and chiral symmetry breaking,* abstract contributed to the Fourth Conference on Intersections between Particle and Nuclear Physics, Tucson AZ, May 24-29, 1991.

H. Burkhardt and J. Lowe, *A global analysis of  $\pi \rightarrow \pi \pi N$  data,* invited talk at the Fourth International Symposium on Pion-nucleon Physics and the Structure of the Nucleon, Bad Honnef, Germany, September 9-13, 1991,  $\pi N$  Newsletter.

H. Burkhardt and J. Lowe, *Amplitudes for  $\pi N \rightarrow \pi \pi N$  reactions,* submitted to  $\pi N$  Newsletter.

- 874** C. Kormanyos, et al. *Nuclear response to quasifree  $K^+$  scattering,* submitted to Spring Meeting- American Physical Society, April 12-15, 1993.

C. M. Kormanyos, et al., *Nuclear quasi elastic  $K^+$  scattering,* Phys. Rev. Lett. 71, 2571 (1993).

- C. Kormanyos, et al., *Quasi elastic  $K^+$  scattering*, Phys. Rev. C51 669 (1995).
- C. M. Kormanyos and R. J. Peterson, *Quasi elastic  $K^+$  nucleus scattering and `swollen nucleons*, Nucl. Phys. A 585, 113 (1995).
- 880** T. Roser, *Properties of partially excited siberian snake, in high energy spin Physics*: 8th Intl. Symposium, ed. K.J. Heller, Minneapolis, MN, 988, AIP Conf. Proc. No. 187 (AIP, New York, 1989), p.1442.
- H. Huang, et al., *The partial siberian snake experiment at the Brookhaven AGS*, Proceedings of the third European particle Accelerator Conf., p. 729 (1992).
- H. Huang, et al., *Preservation of proton polarization by a partial siberian snake*, Physical Review Letters 73, 2982 (1994).
- H. Huang, et al., *Partial siberian snake experiment at the AGS, in high energy spin physics*, 11th Intl. Symposium, ed. K. J. Heller and K. J. Smith, Bloomington, 1994, AIP Conf. Proceedings No. 343 (AIP, New York, 1995), p. 90.
- T. Roser, *Polarized proton beams*, Proc. of 1995 IEEE Particle Accelerator Conf., and Intl. Conf. On High-Energy Accelerators, 3154 (1996).
- H. Huang, et al., *Polarized proton experiment in the AGS with a partial snake*, proc. of 12th Intl. Symposium on High Energy Spin Physics, Amsterdam, 528-530, Sept. 1996.
- H. Huang, et al., *Overcoming weak intrinsic depolarizing resonances with energy jump*, 1997 IEEE Particle Accel. Conf., and Intl. Conf. on High Energy Accelerators, Vancouver, Canada, May, 1997.
- M. Bai, et al., *Overcoming intrinsic spin resonance by using an AC dipole*, 1997 IEEE Particle Accelerator Conf. and Intl. Conf. on High Energy Accelerators, Vancouver, Canada, May 1997.
- M. Bai, et al., *Overcoming the intrinsic spin resonance using resonance island created by RF dipole*, to be submitted to Physical Review (1997).
- M. Bai, et al., *Experimental test of coherent betatron resonance excitations*, Physical Review E, 5 (1997).
- 885** B. Bassalleck, et al., *A multicell target for lambda lambda hypernuclei searches*, by BNL E885 Collaboration, TRI-PP-94-87, Oct. 1994. 2pp, presented at Intl. Conf. on Hypernuclear and Strange Particle Physics (HYP94), Vancouver, Canada, July 4-8, 1994. Published in Nucl. Phys. A585:339c-340c, 1995.
- K. Yamamoto (for the 885 collaboration), *H-dibaryon search via the  $K, K^+$  reaction using a diamond target*, Proceedings of Intl. Conf. On Hypernuclei and Strange Particles, Nuclear Phys. (1997) in press.
- M. May, *Search for nuclei containing two strange quarks*, Proceedings of Intl. Conf. On Hypenuclei and Strange Particles, Nuclear Phys. (1997) in press.
- 887** R. Sawafta, et al., *Do narrow sigma hypernuclear states exist?* Nucl. Phys. A585, p. 103c-108c, 1995.
- 890** M. Clajus, et al., *Eta production in pion interactions with protons and deuterons*, Proc. 6th Intl. Symposium on Meson-Nucleon Physics and the Structure of the Nucleon, Blaubeuren, Germany, July 10-14, 1995, Vol. II, eds. G. J. Wagner, R. Bilger and T. Hehl.
- A. Marusi, *A new test of charge symmetry in eta production on deuterium*, Ph.D. dissertation, U. Of Zagreb, 1996.
- 900** W. Hsi, et al., *Hadron-induced multifragmentation*, Proceedings of XIII Winter Workshop on Nuclear Dynamics, Marathon, FL, Feb. 1-8, 1997.

## Publications

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- W. Hsi, et al., *Formation of hot nuclei with GeV  $\rho$  and  $\pi^-$  beams*. Physical Review Letters, Vol 79, No. 5, p817, Aug 4, 1997.
- V. E. Viola, et al., *Heating the nuclear liquid with GeV hadrons*, Proc. of 8th Intl. Conf. on Nuclear Reaction Mechanisms, Varenna, Italy, June 9-14, 1997.
- W. C. Hsi, et al., *Sideways-peaked angular distributions in hadron-induced multifragmentation: shock waves, toroids or kinematics?*, Indiana Report INC-40007-126 (1997).
- V. E. Viola, et al., *Probing the nuclear EOS with GeV light O ion beams*, to be published in Nucl. Phys. 1997.
- K. Kwiatkowski, et al., *Light-ion-induced multifragmentation*, Proc. 35th Intl. Winter Mtg. On Nuclear Physics, Bormio, Italy, Feb. 1997, ed. I. Iori, p. 432.
- K. Kwiatkowski, et al., *Multifragmentation: Thermal vs. Dynamic effects*, Proc. of 6th Intl. Conf. on Nucleus-Nucleus Collisions, June 2-6, 1997, Gatlinburg, TN; to be pub. In Nuclear Physics.
- 905** T. Nagae, et al., *Observation of a  $^4\text{He}$  bound state in the  $^4\text{He} (\Sigma, \pi^-)$  reaction at 600 MeV/c*, Published in Phys. Rev. Lett. 80, 1605-1609 (1998).
- T. Nagae, *Few-body hypernuclear systems*, Published in Nuclear Physics A631, 363c-375c (1998).
- 906** Y. Yamamoto, M. Wakai, T. Motoba, T. Fukuda, *Production of double-lambda hypernuclei at ( $K^-, K^+$ ) reaction points and their pionic decays*, Published in Nucl. Phys. A625, 107-142 (1997).
- T. Fukuda, invited talk in Proc. of Intl. Conf., on Hypernuclear and Strange Particle Phys, Nuclear Physics A., 1998, in press.
- 907** M.W. Ahmed (for the E907 collaboration), *Characteristics of an active chamber target to locate the reaction vertex in the ( $K^-, \pi^0$ ) reaction*, proc. of the conf. on Kaon and Hypernuclear Physics, BNL, 1997.
- A. Rusek (for the E907 collaboration), *NMS studies of the ( $K^-, \pi^0$ ) reaction*, proc. of the conf. on Kaon and Hypernuclear Physics, BNL, 1997.
- 913** B. M. K. Nefkens,  *$N^*$  physics at the AGS with the crystal ball multiphoton spectrometer*, Inst. For Nucl. Theory, Vol IV, T-S. H. Lee, W. Roberts eds., World Scientific, pg. 186, 1996.
- W. J. Briscoe, *Meson production experiments at TJNAL and BNL*, Inst. For Nucl. Theory, Vol. IV, T-S. H. Lee, W. Roberts, eds., World Scientific, pg. 306, 1996.
- L.X. Jian, L. Addessi, V. Castillo, L.H.Gong, J. Leskowicz, R. Meier, G. Miglionico, J. Scaduto, *Safety design, operation, and control of a liquid hydrogen target at BNL*. Presented at 1997 Cryogenic Engineering Conf., Portland, Oregon, July 28-August 1, 1997.
- W. B. Tippens, (for 913 collaboration), *Hadron spectroscopy with the crystal ball at the AGS*, Presented at Hadron 97, S.U. Chung, ed. (to be published) 1997.
- A. Starostin, *Eta production in the reaction  $\pi^- p$  to  $\eta N$  near threshold*, presented at Hadron 97, S.U. Chung, ed. (to be published) 1997.
- W. B Tippens, (for the 913 collaboration) *Recent results from the crystal ball program at BNL*, proc. Of GW/TJNAF Workshop on  $N^*$  Physics, Oct. 30 - Nov. 1, 1997 (to be published).

# *List of Medium Energy Physics Experimenters*



*Name*

*Affiliation*

*Experiment Number*

**A**

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Abaev, V. V.	Petersburg Nuclear Physics Institute	924, 914, 913, 909, 890
Aclander, H.	Tel-Aviv University	850
Adams, G.	Rensselaer Polytechnic Institute	852
Adams, T.	University of Notre Dame	852
Ahmed, M.	University of Houston	931, 929, 907
Ajimura, S.	Osaka University	930, 929, 906
Akikawa, S.	INS-University of Tokyo	906
Alster, J.	Tel-Aviv University	850, 835
Amann, J.	Los Alamos National Laboratory	933, 931, 907
Androic, D.	University of Zagreb	931, 907
Ashery, D.	Tel-Aviv University	835
Athana, M. J.	Carnegie-Mellon University	788

**B**

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Back, B.	Argonne National Laboratory	917, 900
Bagga, R.	Abilene Christian University	914, 913
Barakat, M.	Louisiana Tech University	931, 907
Barlett, M.	University of Texas	829
Barnes, P.	LAMPF	836, 811
Barnes, P.	Los Alamos National Laboratory	885, 813
Bart, S.	Brookhaven National Laboratory	909, 856, 820
Batinic, M.	Ruder Boskovic Institute	914, 913, 890
Barton, D. S.	Brookhaven National Laboratory	850, 834
Bar-Yam, Z.	University of Massachusetts-Dartmouth	852, 818
Bassalleck, B.	University of New Mexico	926, 906, 885, 865, 813, 811
Batinic, M.	Ruder Boskovic Institute	914, 913, 890
Baturin, V.	Pennsylvania State University	850
Bekrenev, V. S.	Petersburg Nuclear Physics Institute	924, 914, 913, 909, 890
Belzer, L. I.	Moscow State University	852
Berdoz, A.	Carnegie-Mellon University	906, 885, 813
Bennhold, C.	George Washington University	924, 909
Biglan, A.	Carnegie-Mellon University	885
Birchall, J.	University of Manitoba	906, 885
Bishop, J. M.	University of Notre Dame	852
Bonner, B. E.	Rice University	854, 818
Boudrie, D.	Los Alamos National Laboratory	931, 907
Bracken, D. S.	Los Alamos National Laboratory	900
Breuer, H.	University of Maryland	900
Briscoe, W.	George Washington University	931, 924, 914, 913, 909, 907, 905
Brown, D. S.	Northwestern University	852
Bunce, G.	Brookhaven National Laboratory	925, 880, 850, 838, 834, 821
Burger, M.	Freiburg University	813
Bürger, T.	Freiburg University	885, 813

**C**

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Carroll, A. S.	Brookhaven National Laboratory	923, 850, 834
Cason, N. M.	University of Notre Dame	852
Chapman, M.	KEK-National Laboratory for High Energy Physics	936, 813
Chrien, R. E.	Brookhaven National Laboratory	931, 930, 929, 909, 907, 906, 905, 890, 885, 874, 856, 835, 813
Christensen, N.	University of Auckland	850
Chung, S. U.	Brookhaven National Laboratory	852
Clajus, M. H.	University of California-Los Angeles	924, 914, 913, 909, 890
Comfort, J. R.	Arizona State University	931, 914, 913, 907
Courant, H.	University of Minnesota	850, 834
Craig, K.	Arizona State University	914, 913
Crittenden, R. R.	Indiana University	852, 818
Cui, X.	University of Houston	931, 907
Cummings, J. P.	Rensselaer Polytechnic Institute	852

**D**

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Danyo-Blackett, K.	Brookhaven National Laboratory	852
Davis, C.	University of Manitoba	906, 885, 813
Davis, C. L.	University of Louisville	852
Dehnhard, D.	University of Minnesota	931, 907
Demianoi, A.	Moscow State University	852
Denisov, S.	Institute for High Energy Physics-Protvino	852
Deutsch, M.	Massachusetts Inst. of Technology	820
Diebold, G.	Yale University	813
Dorofeev, V. A.	Inst. For High Energy Physics - Protvino, Russia	852
Dowd, J.	University of Massachusetts-Dartmouth	852, 818
Draper, B.	Abilene Christian University	914, 913
Durant, S.	Tel-Aviv University	850
Dushkin, A.	Institute for High Energy Physics-Protvino	852
Dzierba, A. R.	Indiana University	852, 818

**E**

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Edwards, C.	Los Alamos National Laboratory	931, 907
Efendiev, A.	JINR-Dubna	914, 913, 909, 890
Empl, A.	University of Houston	940, 931, 929, 907, 905
Enyo, H.	University of Kyoto	813
Eugenio, P.	University of Massachusetts-Dartmouth	852

**F**

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Fang, G. Y.	University of Minnesota	834
Fickinger, W.	Case Western Reserve University	856, 811
Fischer, H.	University of Freiburg	906, 885, 813
Fischer, H.	University of New Mexico	906, 865
Franklin, G. B.	Carnegie-Mellon University	931, 924, 907, 906, 885, 836, 813
Franz, J.	University of Freiburg	906, 885, 813
Fukuda, T.	INS-University of Tokyo	930, 929, 906, 905
Furic, M.	University of Zagreb	931, 907

**G**

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Gabriel, K.	Pennsylvania State University	850
Gall, K. P.	Boston University	811
Gan, L.	University of Manitoba	906, 885, 813
Gardner, R.	Indiana University	852
Gauland, C.	Arizona State University	931, 907
Gerald, J.	Brookhaven National Laboratory	931, 907
Gibson, A.	Valparaiso University	914, 913
Gibson, B. F.	Los Alamos National Laboratory	931, 907
Gill, D.	TRIUMF	813
Gimeno-Nogues, F.	Texas A&M University	900
Glass, G.	University of Texas at Austin	931, 907
Grosnick, D.	Valparaiso University	924, 914, 913
Gunter, J.	Indiana University	852
Gushue, S.	Brookhaven National Laboratory	910, 909, 900, 895, 866, 850, 834

**H**

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Hackenburg, R. W.	Brookhaven National Laboratory	891, 871, 852
Hashimoto, O.	Tohoku University	931, 930, 907
Hasinoff, M.	University of British Columbia - TRIUMF	936, 926, 811
Hayano, R. S.	University of Tokyo	917, 905, 866
Hayek, M.	University of Massachusetts-Dartmouth	852
Heller, K. J.	University of Minnesota	834
Heppelmann, S.	Pennsylvania State University	850, 834
Hesy, N.	University of Birmingham	811
Hicks, K.	Ohio State University	887, 820
Hiebert, R. C.	Texas A&M University	835

Hoffman, W.	University of Texas	829
Horvath, D.	Central Research Inst. For Physics, Budapest	811
Hotchi, H.	INS - University of Tokyo	906
Hsi, W-Ch	Indiana University	900
Huddleston, J.	Abilene Christian University	914, 913
Hungerford, E. V.	University of Houston	940, 931, 929, 907, 905, 874

## I

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Ichikawa, A.	Kyoto University	885
Iijima, T.	University of Kyoto	813, 811
Iimina, T.	KEK	885
Imai, K.	Kyoto University	906, 885, 813
Isenhower, L. D.	Abilene Christian University	914, 913, 909, 890
Ishikawa, T.	University of Tokyo	930, 917
Ivanov, E. I.	University of Notre Dame	852

## J

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Johnson, K.	Brookhaven National Laboratory	788
Johnson, R. R.	TRIUMF	835
Johnston, K.	Louisiana Tech University	931, 923, 907
Johnston, K.	University of North Carolina	905

## K

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Kachaev, I. A.	Inst. For High Energy Physics - Protvino, Russia	852
Kasprzyk, T.	Argonne National Laboratory	914, 913
Kern, B.	Indiana University	852
Kern, W.	University of Massachusetts-Dartmouth	852, 818
King, E.	University of Massachusetts-Dartmouth	852, 818
Kirk, H.	Brookhaven National Laboratory	910, 818
Kishimoto, T.	Osaka University	930, 929, 906, 829
Knecht, N.	University of Regina	914, 913
Kochetkov, V.	Institute for High Energy Physics-Protvino	852
Kodolva, O. L.	Moscow State University	852
Koetke, D. D.	Valparaiso University	924, 914, 913
Korotkikh, V. L.	Moscow State University	852
Korteling, R.	Simon Fraser	900
Koslenko, N.	Petersburg Nuclear Physics Institute-Gatchina	924, 909, 914, 913, 890
Kostin, M. A.	Moscow State University	852
Krauss, R.	Texas A&M University	820, 835
Kruglov, S. P.	Petersburg Nuclear Physics Institute	924, 914, 913, 909, 890
Kubota, K.	INS-University of Tokyo	906, 905

Kudomi, N.	Osaka University	929
Kuhn, J.	Rensselaer Polytechnic Institute	852
Kulbardis, A.	Petersburg Nuclear Physics Inst.-Gatchina	914, 913
Kurglov, N.	Moscow State University	852
Kwiatkowski, K.	Indiana University	900
Kycia, T. F.	Brookhaven National Laboratory	924, 914, 913, 787

## L

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Lan, A.	University of Houston	931, 929, 907
Landry, M.	University of Manitoba	885, 813
Larson, K. D.	University of New Mexico	811
Lee, L.	University of Manitoba	929, 906, 885, 813
Lefort, T.	Indiana University	900
Leitch, M. H.	Los Alamos National Laboratory	890
Leksanov, A.	Pennsylvania State University	850
Lichtenstadt, J.	Tel-Aviv University	835
Lindenbusch, R.	Indiana University	852
Lipaev, V.	Institute for High Energy Physics-Protvino	852
Lolos, G. J.	University of Regina	924, 914, 913
Lopatin, I.	Pittsburgh Nuclear Physics Institute	924, 914, 913
LoSecco, J. M.	University of Notre Dame	852
Lowe, J.	University of New Mexico	926, 906, 865
Lowe, J.	University of Birmingham	857, 813, 811

## M

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Magahiz, R.	Carnegie-Mellon University	885, 813
Makdisi, Y.	Brookhaven National Laboratory	925, 880, 850, 834
Manak, J. J.	University of Notre Dame	852
Manley, D. M.	Kent State University	924, 914, 913
Manweiler, R. W.	Valparaiso University	924, 914, 913
Mardor, Y.	Tel-Aviv University	850, 835
Marshak, M. L.	University of Minnesota	850, 834
Marshall, T.	Indiana University	818
Marušić, A.	Ruder Boskovic Institute/U.Calif-Los Angeles	924, 914, 913, 909, 890
May, M.	Brookhaven National Laboratory	931, 930, 929, 907, 906, 885
Mayer, C.	Carnegie-Mellon University	906
Mayes, B.	University of Houston	940, 931, 929, 907
McCrady, R.	Carnegie-Mellon University	885, 813
McDonald, S.	University of California-Los Angeles	924, 914, 913, 909, 890
McIntyre, E. K.	Boston University	811
McKerley, M.	Indiana University	852
Measday, D. F.	University of British Columbia	811
Merrill, F.	Los Alamos National Laboratory	885, 813
Meyer, C.	Carnegie-Mellon University	924, 885, 813
Minor, E.	Pennsylvania State University	850

Miyachi, T.	INS-University of Tokyo	905
Mizuno, Y.	Osaka University	929
Moinester, M. A.	Tel-Aviv University	835
Moore, C. F.	University of Texas at Austin	931, 907
Moriwaki, T.	University of California-Los Angeles	914, 913, 909, 890
Morley, K. B.	Los Alamos National Laboratory	933, 920, 900
Morris, C.	Los Alamos National Laboratory	933, 931, 920, 907
Morrison, T.	George Washington University	914, 913, 909, 890
Mulkey, Z.	Abilene Christian University	914, 913
Mutchler, G. S.	Rice University	896, 891, 818
Myuchi, T.	INS-University of Tokyo	906

## N

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Nagae, T.	INS-University of Tokyo	930, 929, 906, 905
Naing, W.	Hampton University	905
Nakano, T.	Osaka University	929, 906, 905, 787
Napolitano, J.	Rensselaer Polytechnic Institute	852
Navon, I.	Tel-Aviv University	850
Neerman, C.	University of North Carolina	905
Nefkens, B.	University of California-Los Angeles	931, 924, 914, 913, 909, 907, 890
Nicholson, H.	Mt. Holyoke College	850
Noble, A.	University of British Columbia	811
Nord, P.	Valparaiso University	914, 913
Nozar, M.	Rensselaer Polytechnic Institute	852

## O

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O'Donnell, J.	Los Alamos National Laboratory	931, 907
Ogawa, A.	Pennsylvania State University	850
Okada, K.	Kyoto-Sangyo University	906, 813
Olchanski, K.	Brookhaven National Laboratory	852
Olshevsky, R.	TRIUMF	835
Omata, K.	INS-University of Tokyo	906
Ostrovidov, A. I.	Moscow State University	852
Outa, H.	INS-University of Tokyo	930, 929, 906, 905

## P

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Page, S.	University of Manitoba	906, 856, 813
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Panebratsev, Y.	J.I.N.R.-Dubna	850
Papandreou, Z.	George Washington University	924, 914, 913, 909, 890
Paschke, K.	Carnegie-Mellon University	906, 885
Patterson, J.	University of Colorado	914, 913
Pedlar, T.	Northwestern University	852
Peng, J-C.	Los Alamos National Laboratory	931, 907, 890
Perepechkin, Y.	INR - Russia	906
Peterson, G. A.	University of Colorado	931, 937, 924, 907
Peterson, J.	University of Colorado	914, 913
Peterson, R. J.	University of Colorado	899, 874
Petkovic, T.	University of Zagreb	931, 907
Phillips, S.	George Washington University	909
Piasetzky, E.	Tel-Aviv University	850, 835
Piekarz, H.	Brandeis University	829
Piekarz, H.	Florida State University	820
Pienkowski, L.	Warsaw University	900
Pile, P. H.	Brookhaven National Laboratory	931, 930, 929, 924, 907, 906, 885, 813
Pinsky, L.	University of Houston	940, 931, 929, 907
Planinic, M.	University of Zagreb	931, 907, 905
Popov, A. V.	Inst. For High Energy Physics, Protvino, Russia	852
Pratt, R.	George Washington University	909
Price, J. W.	University of California-Los Angeles	890
Prohvatilov, M.	INR-Russia	906
Prokop, J.	George Washington University	909
Proskuryakov, A.	Moscow State University	923, 852, 865
Protopopescu, S. D.	Brookhaven National Laboratory	818
Pulver, M.	University of California-Los Angeles	914, 913

## Q

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Quinn, B.	Carnegie-Mellon University	931, 924, 907, 906, 885, 813, 811
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## R

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Ramakrishnan, E.	Texas A&M University	900
Ramirez, A.	Arizona State University	914, 913
Ramsey, W. D.	University of Manitoba	906
Ransom, R.	Rutgers University	885
Rasin, V.	INR-Russia	906
Remsberg, L. P.	Brookhaven National Laboratory	910, 909, 900, 866
Reshetin, A.	INR - Russia	906
Roberts, B. L.	Boston University	857, 821, 811

Roberts, J. B.	Rice University	818
Robinson, D. K.	Case Western Reserve University	856, 811
Roos, P. G.	University of Maryland	931, 907
Roser, T.	Brookhaven National Laboratory	932, 925, 880, 850
Rössle, R.	Freiburg University	813, 811
Rowland, D.	Texas A&M University	900
Rozon, F.	Carnegie-Mellon University	788
Rusek, A.	Brookhaven National Laboratory	931, 930, 907, 906, 905, 885
Russell, J. J.	University of Massachusetts-Dartmouth	850, 838, 834
Rust, D. R.	Indiana University	852
Ryabchikov, D. I.	Inst. For High Energy Physics, Protvino, Rusia	852

## S

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Sadler, M.	Abilene Christian University	914, 913, 909, 890
Saito, N.	University of Kyoto	813, 811
Sajai, E.	Osaka University	929
Sakitt, M.	Brookhaven National Laboratory	856, 811
Salomon, M.	TRIUMF	811
Sanjari, A.	University of Notre Dame	852
Sarycheva, L. I.	Moscow State University	852
Sawafta, R.	Brookhaven Natl. Lab. & North Carolina A&T U.	931, 930, 929, 909, 907, 906, 905, 890, 887, 885, 856, 813
Schmitt, H.	University of Freiburg	906
Schumacher, R. A.	Carnegie-Mellon University	924, 906, 885, 813
Scott, E.	Indiana University	852
Sekimoto, M.	INS-University of Tokyo	906
Seth, K.	Northwestern University	924, 852
Seyfarth, H.	Forschungszentrum Jülich	890
Shafi, A.	George Washington University	914, 913
Shein, I.	Institute for High Energy Physics-Protvino	852
Shephard, W. D.	University of Notre Dame	852
Shibata, T.	Osaka University	829
Shileev, K.	INR - Russia	906
Shimanskiy, S.	J.I.N.R. - Dubna	850
Shimizu, Y.	University of Tokyo	906, 905
Shupe, M. A.	University of Minnesota	834
Sinev, N. B.	Moscow State University	852
Šlaus, I.	Ruder Boskovic Institute	914, 913, 909, 890
Smith, J.	Rensselaer Polytechnic Institute	852
Smith, P. T.	Indiana University	852
Spinka, H.	Argonne National Laboratory	925, 914, 913, 880
Stanislaus, S.	Valparaiso University	924, 914, 913
Starostin, A.	Petersburg Nuclear Physics Institute	924, 914, 913, 890
Staudenmaier, H. M.	University of Karlsruhe	924, 914, 913
Stearns, R.	Vassar College	788, 813
Sukaton, R.	Carnegie-Mellon University	813, 811

Sulanke, T.	Indiana University	852
Sum, V.	University of Manitoba	885, 813, 811
Supek, I.	R. Boskovic Institute	931, 914, 913, 907
Sutter, R.	Brookhaven National Laboratory	931, 929, 909, 907, 906, 905, 890, 885, 856, 813
Sutton, C. S.	Mt. Holyoke College	850
Švarc, A.	Ruder Boskovic Institute	914, 913, 890
Szymanski, J.	Indiana University Cyclotron Facility	788, 813, 811

## T

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Takeutchi, F.	Kyoto-Sangyo University	906, 885, 813
Tamagawa, T.	INS-University of Tokyo	929, 906, 905
Tamura, H.	INS-University of Tokyo	930, 929, 917, 906, 905
Tanaka, M.	Brookhaven National Laboratory	850
Tang, L.	CEBAF	930, 929
Tanida, K.	INS-University of Tokyo	930, 906
Teige, S.	Indiana University	852
Thiessen, A.	Los Alamos National Laboratory	931, 907
Thompson, D. R.	University of Notre Dame	852
Tippens, W. B.	Brookhaven Natl. Lab. & UCLA	931, 924, 914, 913, 909, 907, 890
Totzer, R.	University of New Mexico	813
Tsalov, D.	Pennsylvania State University	850
Tsoupas, N.	Brookhaven National Laboratory	925, 880, 820
Tsvetkov, I. O.	J.I.N.R., Dubna	850

## U

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van Oers, W.	University of Manitoba	906, 885, 813
Viola, V. E.	Indiana University	900

## W

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Ward, H.	University of Texas-Austin	931, 907
Ward, T.	Brookhaven National Laboratory	820
Warner, T.	Boston University	811
Weise, R.	Tel-Aviv University	835
Weygand, D. P.	Brookhaven National Laboratory	852
White, D.	Rensselaer Polytechnic Institute	852
White, D. B.	University of California-Los Angeles	914, 913, 909, 890
Whitehouse, D.	Boston University	811

Wider, M.	Freiburg University	811
Willutzki, H. J.	Brookhaven National Laboratory	852
Wise, J.	Northwestern University	852
Witkowski, M.	Rensselaer Polytechnic Institute	935, 852
Wolfe, M.	University of New Mexico	906, 865, 813, 811
Wu, J. Y.	Pennsylvania State University	850

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**X**

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**Y**

Yamamoto, K.	Kyoto University	906, 885
Yavin, A. I.	Tel-Aviv University	835
Yennello, S. J.	Texas A&M University	900
Yoder N. R.	Indiana University	900
Yokkaichi, S.	University of Kyoto	813
Yosoi, M.	Kyoto University	906, 885

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**Z**

Zeps, V.	University of Kentucky	931, 907, 885
Zhao, D.	Northwestern University	852
Zieminska, D.	Indiana University	852, 818
Ziliak, Z.	Indiana University	852